A SIMULTANEOUS ECONOMETRIC MODEL OF WORLD VEGETABLE TRADE: IMPLICATIONS FOR MARKET DEVELOPMENT

By

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TABLE OF CONTENTS

LIST OF TABLES

Page

Page

Page

LIST OF FIGURES

Page

Abstract of Dissertation Presented to the
Graduate School of the University of Florida in
Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy

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In this dissertation a simultaneous econometric model of world fresh vegetable trade is constructed and estimated. The parameter estimates are then used to simulate the impacts on levels and patterns of trade with changes in key variables in the system. The theoretical basis of the model is Armington's theory of demand as distinguished by place of production. Flexibility in the substitution characteristics of the products is allowed through use of the constant ratio of substitution, CRES, functional form. The system is estimated with two stage least squares, using principal components as instrumental variables.

Statistical results and graphic comparisons of actual and predicted trade quantities indicate that the model does a good job in capturing the economic forces driving

international fresh vegetable trade. The Durbin Watson statistics are usually close to two, indicating little serial correlation and a well specified model. R square statistics, error sums of squares, and Theil inequality coefficients indicate that some of the functional relationships of the model do a better job in capturing the variation and turning points in the dependent variables than do others. Overall, however, the model's performance is quite good.

Trade in fresh vegetables generally occurs within two blocs of the world, the Americas and Western Europe, Asia, and Africa. The largest individual market is the European Economic Community. Parameter estimates indicate that the primary determinant of market shares in the E.E.C. is price competition. This is clear evidence that the Common Agricultural Policy of the E.E.C. has hindered growth of U.S., Latin American, and Canadian exports, as many nations in the Middle East and Africa receive preferential treatment by the E.E.C. while these three do not. However, the growing strength of the Middle East, Far East, and Africa as import markets may facilitate change in the nearly dual bloc nature of vegetable trade and give the American regions, particularly the U.S., a chance to expand their participation in this trade. Parameter estimates indicate that all three American regions are strong competitors in these markets.

CHAPTER I

IMPORTANCE AND CHARACTERISTICS OF INTERNATIONAL TRADE

Introduction

International trade is an important part of the world economy; national economies do not exist in isolation. Trade is an integral part of virtually all nations' economic activities and essentially all national economies are interconnected through trade. The state of a nation's economy and its policies regarding trade will have a large influence on who it trades with and will affect the economies of its trading partners. The more developed, stronger economies of the Western industrialized world, in particular, have major effects on international trade. The trade patterns which occur are greatly influenced by the prevailing economic conditions of the major traders; exchange rates, national incomes, and policies affecting trade.

Trade in agricultural products is an important component of international trade. Virtually all major producers of agricultural commodities export some portion of their production. Export markets for agricultural commodities are often an important source of foreign

exchange and play a vital role in maintaining a favorable balance of trade for producers.

National Agricultural and Trade Policies

In a market where there are no impediments to trade implemented by humans or their institutions, market forces interacting with world economic conditions will determine prices, quantities, and characteristics of the products sold. In such an economic environment, producers and consumers interact to determine prices and quantities. There are no restrictions on product characteristics, and consumers are free to choose those characteristics they find desireable. Trade in this type of market, a free market, is thought to be governed by the principle of comparative advantage. Those countries which can produce a good at a lower cost relative to other nations will export that good, while nations which can only produce it at a relatively high cost will import the good.

In nearly all agricultural commodities, free trade does not exist. Individual nations, or groups of nations, pursue domestic agricultural and trade policies which alter the workings of the market place. Indeed, the primary purpose of these policies is to protect domestic farmers from the vicissitudes of the world market. This is done primarily through subsidizing production, restricting imports, either through tariff or non-tariff barriers, and subsidizing exports.

There have been efforts to move towards free trade in agriculture, especially since World War II. The U.S. has been a strong promoter of these efforts, espousing the philosophy that free trade will benefit all nations. The General Agreement of Tariffs and Trade, GATT, was the first major result of these efforts. GATT contains provisions regarding specific trade barriers and lays out a code of behavior in international trade. A general rule of GATT is that the only legitimate trade barriers are import and export duties; however, it does contain exceptions to this rule. These exceptions were included largely at the request of the U.S. in order to permit domestic agricultural policies to be pursued without significant interference from international trade.

The actions of the U.S., promoting GATT and then insisting on provisions to secure the rights of governments to pursue their own domestic agricultural policies, illustrate the major conflict in agricultural trade. While aware that, according to economic theory, free trade allows for the most efficient distribution of resources, expansion of world production possibilities and the attainment of a higher level of welfare for the people of the world, national governments have strong political and economic incentive to retain control over their domestic agricultural policies. They then use this control to pursue policies to protect their farmers from the fluctuations of the world

market. Once this occurs, and it is the norm, free trade in agricultural products does not exist. While the U.S. generally proclaims the desirability of free trade, it too finds it necessary to adopt protectionist domestic policies. These policies have prevented the U.S. farm sector from having to undergo the painful readjustments which would be necessary if it were completely open to the world market.

The European Economic Community, E.E.C., a major agricultural trader, has one of the most protectionist domestic agricultural programs in the world with its Common Agricultural Policy, CAP. [1] The main purpose of the CAP is to maintain a stable internal farming environment and therefore protect E.E.C. farmers from world price fluctuations in agricultural commodities. This then insulates the farmers of the community from having to adjust to world demand and supply conditions and forces nations with more open agricultural trade policies to accept a larger share of the necessary adjustment. Thus by maintaining price stability within the E.E.C., the CAP forces nations attempting to maintain some semblance of free trade in agriculture to accept more price instability. This requires greater adjustment on the part of their farming sector than would be the case if the CAP was based on the concept of free trade (Fraser, 1975; Fact File,1982;

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[1]. The original members of the E.E.C. were Germany, Belgium-Luxembourg, France, Italy, and the Netherlands. In 1973 it was expanded to include the United Kingdom, Denmark, and Ireland. In 1981 Greece became a member.

Hathaway,1979).

So far, only tariff barriers to trade have been discussed here. However, non-tariff barriers are also formidable obstacles to free trade in agricultural commodities. Some major non-tariff barriers include restrictions on the types of pesticides used, packaging and processing restrictions, seasonal quotas to protect domestic growers, and size and quality requirements. All of these can be and are used to restrict agricultural imports.

Progress in eliminating trade barriers, tariff and non-tariff, is a major factor affecting trade in agricultural products. Given the conflict between domestic agricultural interests and global economic interests, progress in trade barrier reduction is slow. While trade in manufactured goods has, until recently, become freer of restrictions since World War II, trade in agricultural commodities has, if anything, become more protectionist. The Kennedy Round made very little progress in reducing agricultural trade barriers due to the early stage of development of the E.E.C. and the E.E.C.'s insistence that agricultural commodities be considered separately from manufactured goods. The U.S.'s stated position is that in future negotiations, agricultural and manufactured goods will be jointly negotiated and covered by the same agreements.

In sum, protectionist policies have and continue to aid the farm sectors of the nations pursuing them. While this

potentially results in global misallocation of resources to the detriment of the global economy, it also works to mitigate internal farm sector instability. This is domestically both politically and economically desireable. To the extent of the political involvement and power of the farm sector in domestic politics, it may be politically expedient for politicians wishing to obtain or retain national leadership to continue protectionist policies.

The Nature of Competition in Agricultural Trade

Besides following protectionist domestic agricultural and trade policies, nations also seek out new markets and new ways of obtaining or maintaining a competitive edge for their goods. According to economic theory, nations will produce those goods in whose production they have a comparative advantage, then trade for goods in which they do not. In the real world, however, that simple theory is not always borne out. Having a comparative advantage in the production of a good does not necessarily mean a nation will be the most competitive in the good's world market. There are policies and programs that can be and are pursued to enhance the competitiveness of a nation's products such that a comparative disadvantage in production can be overcome.

The E.E.C.'s CAP is very active in this respect. By subsidizing both production and exports, the E.E.C. effectively lowers the price on the world market for its

agricultural products, thus increasing their competitiveness. The E.E.C. also protects its farmers from imports of goods whose world prices may be lower than the reference prices agreed upon for E.E.C. agricultural products. It does this by charging importers a variable levy, with the amount being the difference between the E.E.C. reference price and the world price. Thus all imports into the community are forced to be sold at a price at least as high as the reference prices for the corresponding E.E.C. products.

The U.S. also actively pursues policies to increase the competitiveness of its agricultural products. PL-480 has been a highly successful program in that regard. Designed to provide foreign assistance, it has also greatly facilitated market development, with many of its past recipients currently major purchasers of U.S. farm products. The grain market, in particular, has been expanded by this program (Chambliss, 1982).

The Foreign Agricultural Service, FAS, is another program which promotes U.S. agricultural exports. It maintains eleven trade offices around the world with a variety of functions, all geared to promote U.S. exports. The FAS officers establish and maintain working relationships with business, industry, and government leaders in their area, create opportunities for U.S. products to be sampled using trade shows and other marketing

events, and help U.S. exporters and foreign importers come to mutually beneficial credit arrangements. The officers attempt to understand their area's markets so that they can be more easily penetrated by U.S. exporters (Henke,1983).

Export credits are a market development tool used by most major exporters. These programs provide attractive repayment and interest terms and are used as a method of increasing an exporter's competitiveness. Suppliers are chosen not just on price, quality or transportation, but also on repayment plan periods and interest charges (Tracy,1982).

The U.S. has two forms of export credit, concessional sales and commercial sales. Low income countries benefit from long term concessional credit while middle income countries participate in the commercial credit sales, GSM-102. GSM-102 is handled by the USDA's Commodity Credit Corporation, CCC. The CCC finances an exporter if the commodity in question will further the CCC's long range objectives for market development. This covers sales of virtually all major commodities (Tracy,1982; McElvain,1982).

Transport and shipping is an aspect of trade that can yield one exporter a competitive edge over another. Major factors include costs of shipping, time requirements from port to port, and quality of transport so as to preserve and protect the product. Technological advances in shipping can lower costs and thereby increase profits and

competitiveness. New markets can be developed and time requirements shortened as a result of improvements in carriers and port and terminal facilities (Baker,1978).

Clearly, many factors interact to determine the flow of products between countries. While prices are the allocating mechanism, national governments pursue policies to enhance the competitiveness of their products, often overcoming a comparative disadvantage in production. Governments also pursue policies to insulate their farmers from the effects of the world market, using tariff and non-tariff barriers to keep the world price out of their market and allow a higher price to prevail domestically. This allows a larger and more prosperous domestic agricultural sector to exist, but interferes with the workings of the market mechanism in international trade.

Importance of Vegetable Trade

International trade in fresh vegetables has become increasingly important to both developed and developing nations. United Nations trade data indicate that trade in fresh vegetables, SITC 054, increased about four fold between the years 1962-1982. The total quantities of imports and exports of fresh vegetables among major trading regions, Latin America, the United States, Canada, the E.E.C., the Middle East, the Far East, Africa, and the Non-E.E.C. Western European nations, in 1962 were 3.69 million

and 3.59 million metric tons, respectively. By 1982 those totals had increased to 14.82 and 13.33 million (Table 1.1). These trade data clearly demonstrate tremendous growth in the last two decades. Trading partners have changed, as well as the degree of regional competition. The potential for market growth and, hence, changing market shares, is of paramount importance to those regions attempting to expand their export markets.

In deciding to work with data at the 054 level, all types of vegetables have been aggregated into one category, fresh vegetables. Specifically, the SITC codes of 054.1, 054.2, 054.4, 054.5, and 054.8, or, fresh potatoes, not including sweet potatoes; dried beans, peas, lentils and leguminous vegetables, fresh tomatoes, other fresh vegetables; vegetables frozen or in temporary preservative; and vegetable products, chiefly for human food necessities; have all been aggregated into the section 054 (United Nations,1961). This is a high level of aggregation and includes vegetable subgroups whose characteristics are different; indeed essentially the only trait they all have in common is that of being vegetables. However, this level of aggregation is justified exactly because the purpose of this study is to examine world vegetable trade, its levels and patterns of demand and supply, and how these have changed over time, and not the characteristics of particular subgroups.

TABLE 1.1

IMPORT AND EXPORT QUANTITIES BY REGION, 1962 AND 1982.

Region	1962		1982	
	Imports	Exports	Imports	Exports
	---metric tons---		---metric tons---	
Latin America	204,453	241,001	225,246	193,554
U.S.	315,787	680,314	1,141,592	1,458,805
Canada	464,714	252,491	679,947	684,132
E.E.C.	1,204,242	1,150,762	10,782,704	1,408,266
Middle East	54,086	180,860	198,499	405,670
Far East	73,205	39,976	536,520	7,729,112
Africa	120,444	666,741	504,027	375,745
Non-E.E.C. W. Europe	1,259,439	383,364	758,184	1,073,417
World	3,693,370	3,595,509	14,826,719	13,328,701

Data from the Foreign Trade Statistical Bulletin, Series C, on exports and imports, indicate that, although the demand and supply equations will be estimated at a high level of aggregation, their compositions, in both quantity and value terms, remained relatively constant in the years 1960-1971 (Tables 1.2,1.3,1.4, and 1.5). That is, the proportions of the totals for demand and supply at the 054 level made up of the subsections of 054 remained relatively constant, while the absolute levels did not. Thus, although a high level of aggregation will be used, because each demand and supply function's composition remained relatively constant, it is valid to consider measurements of these functions over time as measurements of relatively unchanging products.

Problem Statement

Trade in vegetables increased dramatically in the twenty-one years from 1962 to 1982 and continues to grow in importance, both in established and emerging markets. This trade is influenced by a number of factors including world economic conditions and national domestic and trade policies. National policies pursued to enhance the competitiveness of products are also important. Thus several factors interact to determine the flow of vegetables around the world; vegetable trade is not simply driven by the principle of comparative advantage in production. Nor

TABLE 1.2

COMPOSITION OF TOTAL U.S. EXPORTS OF SITC CODE 054.[a]

Year	SITC	Quantity	Value[b]	% Quantity	% Value
		---metric tons---	---$1,000 U.S.---		
1959	054	786,823	110,218	100.00	100.00
	054.1	134,213	8,443	17.06	7.66
	054.2	301,254	90,670	38.29	82.26
1962	054	687,481	104,964	100.00	100.00
	054.1	103,290	6,458	15.02	6.15
1965	054	696,631	112,571	100.00	100.00
	054.1	75,580	6,776	10.85	6.02
	054.2	263,591	40,868	37.84	36.04
	054.4	44,394	9,671	6.37	8.59
	054.5	293,059	37,192	42.07	33.04
	054.6	6,767	3,475	.97	3.90
	054.8	13,240	14,589	1.90	12.96
1970	054	885,214	145,564	100.00	100.00
	054.1	140,953	10,163	15.92	6.98
	054.2	357,852	64,410	40.43	44.25
	054.4	40,447	8,885	4.57	6.10
	054.5	321,700	44,511	36.34	30.58
	054.6	11,739	4,398	1.33	3.02
	054.8	12,523	13,197	1.42	9.07
1975	054	1,095,426	339,796	100.00	100.00
	054.1	210,929	21,318	19.26	6.27
	054.2	306,688	144,991	28.00	42.67
	054.4	91,886	31,745	8.39	9.34
	054.5	441,794	104,970	40.33	30.89
	054.6	31,907	17,394	2.91	5.12
	054.8	12,222	19,378	1.12	5.70

[a]Other export supply functions analyzed in exactly the same manner include those of Canada, the United Kingdom, and the Netherlands, the last two of which yield an approximate measure of the composition of the E.E.C.'s export supply function.

[b]Exports measured FOB.

TABLE 1.3

COMPOSITION OF U.S. EXPORTS TO CANADA.

Year	SITC	Quantity	Value[a]	% Quantity	% Value
		---metric tons---	---$ 1,000 U.S.---		
1963	054	404,955	47,113	100.00	100.00
	054.1	84,787	3,983	20.94	8.45
	054.4	44,895	8,847	11.09	18.78
	054.5	28,453	8,060	7.02	17.11
1965	054	378,208	53,606	100.00	100.00
	054.1	69,771	6,152	18.45	11.48
	054.4	43,681	9,464	11.55	17.65
1970	054	456,638	60,188	100.00	100.00
	054.1	122,652	8,523	26.86	14.16
	054.4	39,608	8,611	8.67	14.31
	054.5	276,985	36,541	60.66	60.71
1975	054	684,680	151,734	100.00	100.00
	054.1	182,940	16,009	26.72	10.55
	054.4	69,417	30,569	10.14	20.15
	054.5	382,816	86,173	55.91	56.79

[a]See footnote b of TABLE 1.2.

TABLE 1.4

COMPOSITION OF U.S. EXPORTS TO THE UNITED KINGDOM.

Year	SITC	Quantity	Value[a]	% Quantity	% Value
		---metric tons---	---$1,000 U.S.---		
1963	054	150,049	24,161	100.00	100.00
	054.1	30	2	.02	.01
	054.4	22	6	.01	.02
1965	054	90,166	13,742	100.00	100.00
	054.1	21	3	.02	.02
	054.4	46	10	.05	.07
1970	054	85,294	14,613	100.00	100.00
	054.1	.	.	.	.
	054.4	30	9	.04	.06
	054.5	8,009	1,342	9.40	9.18
1975	054	49,010	22,707	100.00	100.00
	054.1	.	.	.	.
	054.4	72	26	.15	.11
	054.5	5,068	1,449	10.34	6.38

[a]See footnote b of TABLE 1.2.

TABLE 1.5

COMPOSITION OF CANADA'S EXPORTS TO THE U.S.

Year	SITC	Quantity	Value[a]	% Quantity	% Value
		---metric tons---	---$1,000 U.S.---		
1963	054	105,611	6,193	100.00	100.00
	054.1	43,964	2,162	41.63	34.91
1965	054	190,413	14,499	100.00	100.00
	054.1	129,588	10,079	68.06	69.52
	054.4	933	327	.52	2.26
1970	054	151,977	13,443	100.00	100.00
	054.1	77,944	5,139	51.29	38.23
	054.4	1,483	626	.98	4.66
	054.5	74,663	6,012	49.13	44.72
1975	054	143,780	20,899	100.00	100.00
	054.1	65,134	6,023	45.30	28.82
	054.4	509	277	.35	1.33
	054.5	69,319	10,148	48.21	48.56

[a] See footnote b of TABLE 1.2.

is trade in vegetables static; as economic conditions, domestic policies and perhaps even the structure of the trade environment change, forces are set in motion to cause adjustments in vegetable trade patterns.

This study will examine world trade in vegetables over several years. Vegetable trade depends directly on the importing countries' demand for the particular product. Demand may differ according to the source of supply. National or regional domestic agricultural, trade, and policies to enhance product competitiveness also likely have a direct effect on product demand and available supplies. Income effects and demographic patterns must also be accounted for when estimating demand equations.

An empirical measurement of these demands is essential to evaluate pricing policies and to form long run trade projections. Empirical demand estimates show the relative growth as well as differences among competing products. The price parameters can be used to explore differential pricing policies and for measuring the impacts or differences in trade barriers.

Specific objectives for the research project are:

(1) Develop the theoretical demand and export supply models for selected vegetables traded internationally. These models should reflect demand differences due to quality, that is point of origin, differences due to national incomes , populations, prices of other goods, and the structure of the international trade environment, including major trade regions, trade barriers and preferential treatments. The export supply equations should reflect the unique production capabilities of each country

or region as well as the exporters' responsiveness to the average export price.

(2) Estimate demand and supply equations for each major trader simultaneously in a world trade model.

(3) Provide insights into the policy implications for differences in vegetable demands for alternative production sources.

Scope

The purpose of this study is to estimate the demand and export supply for fresh vegetables for each of the major trading regions of the world. A world trade model will be constructed that takes into account trade conditions such as tariff policies, exchange rates, levels of economic activity, demographics, and national or regional agricultural policies. Demand and export supply equations will be estimated simultaneously within the constructs of this model to allow for the estimation of consistent parameter estimates. Quantities and prices of vegetables will be analyzed at the 054 level which is defined as fresh or dried vegetables, roots and tubers (United Nations,1961).

Methodology

A world trade model based on one outlined by Armington which distinguishes between products by place of production will be constructed (Armington,1969). In this model, total import demand for a good such as vegetables will first be determined; this import demand will then be independently allocated among competing sources of supply, or products. A

constrained estimation procedure will be used to guarantee that estimated world exports equals world imports.

Econometric procedures will be used, within the constructs of this model, to estimate demand and export supply equations. A simultaneous system will be used as it is likely, when estimating demand and supply equations in international trade research, that the use of ordinary least squares would yield biased and inconsistent results.

The structure of the international trade environment will be built into the trade model. That is, demand equations will be specified for only the major traders, be they countries, blocs of countries or regions. Likewise, export supply functions will be specified for each of the major traders. Tariff barriers and preferential treatments will be incorporated into the model with equations linking regional CIF, cost of insurance and freight, prices with regional market prices. The market prices are then used to estimate demand equations. For those suppliers facing tariff barriers into an import market, the market prices of their products in that market will be higher than those of other suppliers, and consequently one would expect the demand for their products to be lower. For those receiving preferential treatment, the prices of their products will be lower, and in all probability, demand will be higher.

World economic conditions will also be incorporated into the trade model. Exchange rates and transportation and

distribution costs will all be reflected in the market prices of the products. National incomes and demographic patterns will be incorporated into demand equations.

Implementation of the world trade model will yield insights into vegetable trade among the major participants. Demand and export supply equations will be estimated and numerical values obtained for parameters. Knowledge of the parameter values will give policy makers valuable insights as to the impacts which could be expected through the implementation or changing of a policy. The insights gained by use of the model could be used by policy makers to arrive at more knowledgeable decisions regarding their country's participation in world vegetable trade.

Thus, construction of a world trade model which distinguishes products by place of production, estimates demand and export supply equations within a simultaneous system and only for the major traders, has market prices which reflect the prevailing tariffs and preferential treatment agreements, and demand equations which take into account both world and national economic conditions, will accomplish objectives numbers one and two. Careful consideration of the results will yield insight into the impacts of policies on demands for products distinguished by place of production, which will accomplish objective three. These insights could be quite valuable for government policy makers attempting to increase the benefits

to their nation from participation in international vegetable trade.

Overview

Chapter I has set the stage for this project. The world wide importance of trade has been discussed, with emphasis on agricultural trade and fresh vegetables in particular. The growth in fresh vegetable trade from 1962 to 1982 was remarkable. This growth merits study to discover the major factors behind it and the strengths of these factors. Chapter II will discuss the levels and patterns of trade and production in vegetables among the major traders for the years 1962 to 1982. These patterns will be incorporated into the world model. Chapter III will review the relevant literature and Chapter IV will present the theoretical model, based on Armington's theory of demand distinguished by place of production. Chapter V will discuss the relevant econometric issues for estimation of the model. The empirical estimates will be presented and analyzed in Chapter VI. Simulations of the effects on the trade system of changes in exogenous variables will be discussed in Chapter VII. Chapter VIII will discuss the implications of the study, with particular emphasis on policy implications for the U.S. Chapter IX will review the study and present its conclusions, as well as possibilities it suggests for future research. Together the chapters will

comprise a dissertation which uses a simultaneous system to estimate the demand and export supply parameters for fresh vegetables as distinguished by place of production, uses these estimates to simulate the effects on the system of changes in exogenous variables such as tariff levels, national incomes, and population levels, and goes on to discuss the policy implications of these parameter estimates and simulated scenarios.

CHAPTER II

CHARACTERISTICS OF TRADE AND PRODUCTION OF FRESH VEGETABLES WORLD-WIDE

Introduction

The purpose of this chapter is to present the world patterns of trade and production in fresh vegetables as revealed by U.N. data. Absolute levels of production, inter- and intraregional trade are examined as well as percentages of world totals, growth rates, and major directions of trade. The major trading regions are also discussed.

In order to begin the analysis the world was divided into eight regions: Latin America, the United States, Canada, the E.E.C., the Middle East, the Far East, Africa, and the Non-E.E.C. Western European nations. These divisions were determined by considering the strength and manner of participation in the world economy. For example, while the U.S. and Canada are both strong participants in the world economy, there are no Latin American nations that have an impact such as to be considered on an equal basis with these two. However, as a region Latin America has a strong level of participation in world trade. The same holds true for the Middle and Far Eastern nations, Africa,

and the Non-E.E.C. Western European nations. The E.E.C., which acts as a single economic unit with regards to world trade, should obviously be considered as one region and not separate nations. Only market economies are considered in this study, excluding the Eastern European nations as well as China and Cuba.

The U.N. trade data of SITC 054 and FAO production data covering the equivalent commodities for 1962 through 1982 are used. During that time period many changes occurred in the world trading environment, one of the most significant being the expansion of the E.E.C. in both numbers of members and economic impact on international trade. All E.E.C. members participate in the Common Agricultural Policy which, among other policies, has strong barriers to entry for agricultural imports. The E.E.C. also has preferential trading agreements with many of the Mediterranean and African nations, which tend to distort levels and patterns of trade from those that would be observed if free trade existed. In 1973 the E.E.C. admitted Great Britain, Ireland, and Denmark to the original six members of France, Germany, Italy, Belgium, Luxembourg, and the Netherlands. In 1981 Greece became a member. In order to see the impacts of these expansions on trade, statistics for the years before and the years of the expansions are presented. Also, in order to detect the trends going on in levels and patterns of trade, tables are

presented in approximately five-year intervals. These tables are all found in Appendix C.

Levels, Percentages, and Growth of Production

Table 2.1 presents levels of production by region, regional percentages of total world production of fresh vegetables for 1962 and 1982, and the 1982 levels divided by the 1962 levels. This final column will be interpreted as a growth rate for production levels. Thus world production of fresh vegetables grew at a rate of 1.39 from 1962 to 1982; that is, the 1982 level was 1.39 times the 1962 level. The regions showing the highest rates of growth were the Middle East at 4.40, Canada at 1.71, and Africa at 1.69. Those regions which produced the largest percentages of total supples of fresh vegetables in both 1962 and 1982 were the Far East, Africa, Western Europe, and Latin America, respectively.

Levels, Percentages, and Growth of Trade

Tables 2.2, 2.3, and 2.4 use 1962 as a base and present the ratios of 1982 quantities of imports and exports for inter- and intraregional trade to 1962 quantities by region and for the world as a whole, where the world consists of the eight regions selected for this study. The absolute levels of intraregional trade were much higher than those of interregional trade, 550,000,000 versus 3,693,370 in 1962

TABLE 2.1

LEVELS, PERCENTAGES AND GROWTH OF PRODUCTION OF FRESH VEGETABLES, 1962 TO 1982.

Region	1962	% of World	1982	% of World	1982/1962
	---metric tons---		---metric tons---		
Latin America	45,318,517	8.31	69,589,880	9.20	1.54
U.S.	31,809,228	5.83	46,547,992	6.15	1.46
Canada	3,429,409	0.63	5,861,669	0.77	1.71
W. Europe[a]	105,171,715	19.28	98,171,002	12.98	0.93
Middle East	10,526,320	1.93	46,266,742	6.12	4.40
Far East	290,000,000	53.16	390,000,000	51.56	1.34
Africa	59,232,133	10.86	100,000,000	13.22	1.69
World	545,487,322	100.00	756,437,285	100.00	1.39

[a]The E.E.C. and non-E.E.C. W. European region are not presented separately because, although the countries in Europe considered in this analysis did not change, for some their status as E.E.C. members did. Thus, the composition of the two regions changed from 1962 to 1982. If the two regions were presented separately it would be unclear as to what had caused growth or lack of growth; expansion in members or a change in the level of participation in trade. The important issue in this table is the absolute level of change in European interregional trade.

TABLE 2.2

LEVELS OF GROWTH OF INTERREGIONAL IMPORT QUANTITITES, 1962 TO 1982.

Region	1962	1982	1982/1962
	---metric tons---	---metric tons---	
Latin America	204,453	225,246	1.1017
U.S.	315,787	1,141,592	3.6151
Canada	464,714	679,947	1.4632
W. Europe[a]	2,463,681	11,540,888	4.6844
Middle East	54,086	198,499	3.6701
Far East	73,205	536,520	7.3290
Africa	120,444	504,027	4.1847
World	3,693,370	14,826,719	4.0144

[a]See footnote a of TABLE 2.1.

TABLE 2.3

LEVELS AND GROWTH OF INTERREGIONAL EXPORT QUANTITIES, 1962 TO 1982.

Region	1962	1982	1982/1962
	---metric tons---	---metric tons---	
Latin America	241,001	193,554	0.8031
U.S.	680,314	1,458,805	2.1443
Canada	252,491	684,132	2.7095
W. Europe[a]	1,534,126	2,481,683	1.6177
Middle East	180,860	405,670	2.2430
Far East[b]	109,873	7,729,112	70.3459
Africa	666,741	375,745	0.5636
World	3,595,509	13,328,701	3.7070

[a]See footnote a on TABLE 2.1.

[b]1962 was an abnormally low year for Far Eastern exports, therefore the 1963 level of 109,873 was used.

TABLE 2.4

LEVELS AND GROWTH OF INTRAREGIONAL IMPORT QUANTITIES, 1962 TO 1982.

Region	1962	1982	1982/1962
	---metric tons---	---metric tons---	
Latin America	45,248,604	68,817,734	1.52
U.S.	31,452,394	46,489,441	1.48
Canada	3,651,676	6,045,948	1.66
W. Europe[a]	106,341,421	107,494,045	1.01
Middle East	10,368,301	45,757,430	4.41
Far East	290,000,000	380,000,000	1.31
Africa	58,395,811	100,000,000	1.71
World	550,000,000	750,000,000	1.36

[a]See footnote a on TABLE 2.1.

and 750,000,000 versus 14,826,719 in 1982 for imports. However, the levels of growth were higher for interregional than intraregional trade, 4.01 versus 1.36.

Comparing Table 2.1, levels of production, with Tables 2.2 and 2.4, levels of inter-and intraregional trade, it is clear that the vast majority of fresh vegetables remain in the region in which they are produced. These are not the vegetables of interest in this dissertation. This study analyzes fresh vegetables traded between regions. While these make up a small percentage of total fresh vegetable production, their share is growing rapidly. The level of growth of this type of vegetable trade has been strong enough to merit a study to discover the strength of the forces underlying this growth.

Those regions which were strong participants in this growth of interregional trade on the import side were the Far East , Western Europe, and Africa, with levels of growth exceeding the overall world level. The Middle East and the U.S. also had significant levels of growth in their import markets, although less than the overall world level. Latin America and Canada had a moderate amount of growth. On the export side, the strongest growth was registered by the Far East, distantly followed by Canada, the Middle East, the U.S., and Europe. Latin American and African exports declined dramatically to only .80 and .53 of 1962 levels.

Table 1 of Appendix B presents the import quantities and percentages of interregional world vegetable imports by region for each of the years 1962 to 1982. The major importing regions, by a large percentage, were the two European ones. In 1962 the E.E.C. imported 33 percent of total world imports and the Non-E.E.C. Western European nations 34 percent. Together they comprised 67 percent of the world market for fresh vegetables. This grew a small amount throughout the years 1962 to 1982, reflecting the fact that the European growth in imports of fresh vegetables was only slightly larger than total world growth; in 1982 with 78 percent of the import trade, European imports dominated world vegetable imports. With the addition of new members to the E.E.C. in 1973 and 1981, the region composed of the rest of the Non-E.E.C. Western European nations declined in membership and there was a noticeable shift in percentages with the E.E.C. becoming a larger importer and the Non-E.E.C. Western European region a smaller one.

Following the two Western European regions, the largest importers of fresh vegetables were Canada, the U.S., and Latin America. Their percentages of world imports in 1962 were approximately 13, 9, and 6, respectively, and in 1982, 5, 8, and 2. These numbers reflect that, of these three regions, none had growth rates exceeding or even meeting that of the world average, and thus all three regions declined in their shares of world imports. Table 1,

Appendix B, demonstrates that Canada and Latin America, while importing fairly large quantities, basically maintained their status quo as importers. In 1962 Africa, the Far East, and the Middle East had approximately 3 ,2, and 1 percent of world imports and in 1982, 3, 4, and 1. Africa and the Far East increased the absolute levels of their import quantities, and at a growth rate exceeding that of the world average. Consequently, their percent of world imports increased. The Middle East, while showing strong growth, did so at a level below the world level.

Table 2 of Appendix B presents the export quantities and percentages of interregional vegetable exports by region for each of the years 1962 to 1982. The European regions again dominated, although not to the extent they did in imports. Also, the percentage of world exports originating in the European regions declined from 1962 to 1982, reflecting the fact that their level of export growth was below the world average. In 1962 the E.E.C. exported approximately 32 percent of total world fresh vegetable exports while the Non-E.E.C. Western European region exported approximately 11 percent, or a total of 43 percent of world exports originated in Europe. In 1982 the percentages were 11 and 8, or a total of 19 percent.

In 1962 the major non-European exporting regions were the U.S. with 19 percent and Africa with 18 percent. Both declined in their shares from 1962 to 1982. Africa showed a

dramatic decline, from 18 to 3 percent. The U.S. had a much less dramatic drop, from 19 to 11 percent. These percentages reflect the fact that Africa did not even maintain its absolute quantity level; its quantity level in 1982 was only approximately .56 of what it was in 1962. The U.S., while not meeting the world growth rate of 3.71, at 2.14 did more than double its levels of export quantities.

The strongest region in terms of export growth was the Far East. With a growth rate of 70.34, in 1963 the Far East exported approximately 3 percent of world totals; in 1982 that had increased to almost 58 percent.

Canada, while decreasing in its percentage of world totals from 7 to 5 percent, showed an absolute growth rate of 2.71 from 1962 to 1982. While this did not meet the world growth rate, it does show Canada experienced strong growth in its exports of fresh vegetables. The Middle East also showed strong growth in its exports. At 2.24 it was below the world rate of 3.71, nevertheless it more than doubled its exports.

To summarize, on the import side the fastest growing regions were the Far Eastern and European regions. By 1982, while the Far East still made up a small percentage of total world imports, it had increased dramatically from 1962. Europe increased somewhat from 67 percent of the world's imports of fresh vegetables. The other regions with strong

growth in their vegetable imports were Africa, the Middle East, and the U.S. Of these, only Africa's rate of growth exceeded the world rate and therefore the percentage of total imports to the Middle East and the U.S. declined from 1962 to 1982.

The regions showing the strongest growth on the export side were the Far East and Canada. The Middle East, the U.S., and the two European regions also showed growth in their exports. Latin American and African exports declined on an absolute level, consequently their levels of growth were below one.

The fact that the combined European regions were among the fastest growing for vegetable imports and comprised the largest markets for vegetables has major implications. The CAP is a very effective mechanism for limiting imports into the E.E.C. from those nations or regions with which it does not have preferential trading arrangements The U.S. is one of those regions. It is very possible that the CAP has hindered the growth of U.S. exports of fresh vegetables, keeping the growth rate of U.S. exports below the world rate. On the other hand, the Middle East and Africa both have preferential arrangements with the E.E.C. This may partially account for the strong growth in Middle Eastern exports. Theoretically, the preferential treatment should give Africa a comparative advantage in the E.E.C. market, which should contribute to growth of African exports.

However, Africa's exports declined dramatically from 1962 to 1982. The empirical results of the trade model should yield some insights into this phenomenon.

Patterns of Trade

Introduction

Tables 1 through 7 of Appendix C present interregional import quantities by region by partner region for the years 1962, 1967, 1972, 1973, 1980, 1981, and 1982. Tables 8 through 14 of Appendix C present export quantities by region by partner region for the same years. These tables will be used to determine major patterns of world trade in vegetables; who traded with whom and how this changed in the time period under consideration.

There is a great deal of information contained in each of the tables in Appendix C. They all follow the same format and in order to extract their information, one must understand how it is presented. The following few paragraphs is a discussion to aid in that understanding. It is presented from the import side.

Tables 1 through 7 of Appendix C each present import quantities by region by partner region for a particular year. The regions are the importers, the partner regions are who they import from. Along the right hand side of each table are numbers; these are row sums which tell the total quantity imported by each region for that year. Beneath the

quantities are smaller numbers; these are the percentages of total world imports received by each of the regions. These quantities and percentages match those in Table 1 of Appendix B which presents quantities and percentages of imports by region by year. At the bottom right corner of each of the tables of Appendix C is a number which sums all of the row totals and consequently is total world imports for a particular year. Along the bottom of the table are column sums. These delineate the total quantities of imports obtained from each of the partner regions. Beneath the quantities are the percentages of total world imports supplied by each partner region. The column sums can also be summed to obtain total world imports.

In the top left hand corner of the tables are the four words frequency, percent, row percent, column percent; one under the other. These delineate the types of numbers found in each square of each of the tables. The top number is the frequency, or quantity of imports to a specified region from a specific partner region. The second number is the percent of total world imports for that year which the trade between the two specified traders comprised. The third number, row percent, is the percent of total imports to a particular region from a specified partner region. The final number, column percent, is the percentage of the total world imports from a particular partner region going to a specified region.

As an example, Table 1, Appendix C, presents import quantities by region by partner region for 1962. Looking at Latin America as the region and the U.S. as the partner region, Latin America imported 64,055 metric tons from the U.S. in 1962. This comprised 1.73 percent of total world imports for that year. Latin America obtained 31.33 percent of its imports from the U.S. and of all the world's imports from the U.S., 9.52 percent went to Latin America.

This example illustrates what a wealth of information is contained in each of these tables. They will be used to discern patterns of world vegetable trade, which are discussed in the following few pages.

Observed Patterns in Imports

Recalling that the two Western European regions were by far the largest importers of fresh vegetables, Tables 1 through 7 of Appendix C reveal that they obtained a large percentage of their vegetables by importing among themselves. This pattern became less prevalent for the E.E.C. from 1962 to 1982, from 25 percent to 10 percent, while the opposite occurred for the Non-E.E.C. Western European region. The expansion in membership of the E.E.C. caused an increase in the Non-E.E.C. Western European region's imports from the E.E.C. In 1962 this region received approximately 58 percent of its imports from the E.E.C. These percentages remained essentially constant

until 1973 when, with the addition of the U.K., Denmark, and Ireland to the E.E.C., they jumped to 74 percent, and in 1981, 73. The addition of Greece to the E.E.C. in 1972 appeared to have less impact than the addition of the U.K., Ireland, and Denmark, although other factors could be masking its effect. In 1981 the Non-E.E.C. Western European region received 73 percent of its imports from the E.E.C. In the early 1960s the E.E.C. received the bulk of its vegetable imports which did not come from European sources from Africa, but by 1967 the Far East was becoming a primary source, with the percentages of E.E.C. imports obtained from each approximately equal. However, the Far East rapidly overtook Africa and by 1982 the E.E.C. obtained 79 percent of its interregional imports from the Far East and only 3 percent from Africa. Thus there was a shift in E.E.C. imports away from Africa and Europe as suppliers and towards the Far East. This is consistent with the growth levels observed in the exports of these three regions; Far Eastern exports increased 70 times over, European almost 2 and African exports in 1982 were only .56 of 1962 levels. The Non-E.E.C. Western European region had more varied sources for its non-European vegetable imports than the E.E.C. In the early 1960s these other sources were Africa, the Middle East and the U.S., in that order. In 1973 Latin America also began to supply a significant proportion and the region's share of its imports from the E.E.C. began to

increase. From 1973 on, with the E.E.C. percentages increasing, Latin America, the U.S. and the Middle East maintained their shares while Africa's declined.

The largest importers after the European blocs were Canada, the U.S., and Latin America. In the 1960s the U.S. supplied approximately 92 percent of Canada's imports, Latin America supplied 7 percent, and the Non-E.E.C. Western European region approximately 1 percent. The 1970s and 1980s showed an increasing dominance by U.S. suppliers to the point that all other regions were essentially excluded. In 1982 the U.S. supplied 93 percent of Canada's vegetable imports with Latin America supplying approximately 5 percent.

The U.S. obtained the bulk of its vegetable imports from Latin America and Canada, in that order. The European blocs supplied a small amount, although their total percentage declined and was almost completely taken over by E.E.C. supplies as this region grew in numbers. In the 1960s and 1970s Latin America supplied an increasing percentage of U.S. imports, with Canada a decreasing one. In the 1980s that trend was reversed, nevertheless, in 1982 Latin America still supplied 68 percent and Canada 30 percent of U.S. fresh vegetable imports. Thus the large majority of U.S. vegetable imports in 1982 were obtained from Latin America.

In 1962 Latin America received 38 percent of its interregional imports from the E.E.C., 31 percent from the U.S., and 25 percent from Canada. These three regions continued to dominate Latin America's imports throughout the 1960s, with the Non-E.E.C. Western European region's percentage also growing. In the 1970s and 1980s the U.S. became dominant such that by 1982 the U.S. supplied 54 percent of Latin America's imports with the E.E.C. supplying only 21 percent.

Throughout the two decades, Africa imported a small percentage of total world imports but showed itself to be a strong growth market. In the early 1960s the E.E.C. and the Middle East were its primary suppliers with the U.S. and Latin America supplying a small percentage of its imports. By 1967 the Non-E.E.C. Western European region had emerged as an important source and throughout the 1960s these were the major suppliers to Africa. In the 1970s and 1980s, the Non-E.E.C. Western European region dropped off. By 1982 the E.E.C. supplied 64 percent and the Middle East 24 percent of Africa's imports. Data from 1981 and 1982 also indicate that the U.S. and Latin America were gaining a stronger hold on the African import market.

In 1962 the Far East received the majority of its vegetable imports from Africa, the U.S., and the E.E.C., with about 25 percent from each. The Middle East supplied approximately 11 percent. In the 1970s and 1980s supplies

from the E.E.C. and Africa declined while those from the U.S. increased. Oceania also began to be a major supplier to the Far East, but this region had such a small level of participation in world vegetable markets that it is not discussed in this study. In the 1980s the Middle East also began to be a significant supplier to the Far East.

In 1962 the Middle East imported primarily from the Non-E.E.C. Western European region, Africa, and the Far East. In the 1970s the E.E.C. became a primary supplier but this dropped off in the 1980s and the Far East became a major supplier. By 1982 the Far East supplied 63 percent of the Middle East's imports, Africa 16 percent, and the E.E.C. 12 percent.

To sum up patterns observed in vegetable imports from 1962 to 1982, the majority originated and were received in Europe. Major European suppliers from outside Europe were Africa and the Far East for the E.E.C. and the Middle East, Africa, U.S., and Latin America for the Non-E.E.C. Western European region. There was a great deal of activity between the European blocs, the Far East, Middle East, and Africa, with each of these being significant suppliers for the others, at least at some point in the time interval being considered.

Within the Americas, there was a great deal of trade between the U.S., Canada, and Latin America. Canada received virtually all of its imports from the U.S. and the

U.S., the bulk from Latin America and Canada, in that order. Imports to Latin America were negligible, but of the amount that existed, a great deal of it was from the U.S.

Percentage-wise there was not a great deal of trade between Europe and the Americas, although the absolute quantity levels were high. Given the volume of vegetable trade the European blocs engaged in, even the fairly high quantity levels received from the U.S., Latin America, and Canada made up a small percentage of their total imports. Latin America did receive a high percentage of its imports from the European regions throughout the time period 1962 to 1982. All three of these regions exported to the Middle East, Far East, and Africa, although the U.S. was the most significant supplier. However, the American regions received essentially no imports from these three regions.

Observed Patterns in Exports

The majority of world exports of fresh vegetables originated and were traded in Europe. From 1962 to 1982 European exports declined as a percentage of world totals, but of Non-E.E.C. Western European exports, the percent traded with the E.E.C. increased while the opposite was true of E.E.C. exports. As with imports, there was a significant amount of activity between the European blocs, Africa, the Middle East, and the Far East. In the 1960s and early 1970s, the E.E.C. was a major market for African vegetables

and by 1982 was a major market for Far Eastern and Middle Eastern exports, which were both growing rapidly. Africa declined in importance as an exporter of fresh vegetables (Tables 8 through 14, Appendix C).

There was a significant amount of trade between the U.S., Canada, and Latin America, with the majority of their exports remaining within the Americas. However, a fair amount of exports from the Americas were destined for Europe and some to the Middle East, Far East and Africa.

Conclusion

It is clear from the discussion of trade levels and patterns, and Table 2.1, that the growth and changes which occurred in the trade of fresh vegetables had little to do with its production characteristics. Trade in 1982 was more than 3.7 times its level in 1962, production grew at a rate of less than 1.5. The Middle East, which experienced the strongest growth in its production levels, also experienced very strong growth in its imports. The Far East, whose production grew by less than the world rate and whose percentage of total world production thus declined from 1962 to 1982, experienced the strongest rate of growth of its exports. It appears then that supply characteristics are not the driving forces behind international trade in fresh vegetables. This study will focus primarily on the demand side in an attempt to discover and measure the strengths of the factors which drive this trade.

This chapter presented statistics regarding levels for both trade and production, percentages, and rates of growth, and patterns of trade among the eight trading regions in fresh vegetables from 1962 to 1982. These data illustrate that, while production grew only slightly, trade in this commodity grew substantially in this time period. Also, the patterns of trade were not static and were apparently not related to patterns in production levels. There were changes in the patterns of demand and supply between the regions from 1962 to 1982 which were contrary to what one would expect by looking at production levels. The regions experiencing strong growth in their production levels also had strong growth in their imports, the region with the strongest growth in its exports had one of the weakest levels of growth in production. The growth in the levels and shifts in the patterns of trade, apparently unrelated to levels and patterns of production growth, are evidence that there were strong economic forces at work on the demand side causing major changes in international fresh vegetable trade from 1962 to 1982.

This study is an attempt to identify what the forces are that are causing changes in the levels and patterns of trade of fresh vegetables and to determine their relative strengths for each of the major traders. With the growth and changes that have occurred in vegetable trade, there is room for growth of U.S. exports. The information provided

by this study could be used by policy makers to facilitate increasing U.S.' exports and the U.S.' market share of other regions' import demands.

CHAPTER III

LITERATURE REVIEW

Introduction

This chapter will provide a discussion of previous studies of international trade for the purposes of gaining some insight on the approaches of other authors and providing a foundation for evaluating the contribution of the present study. There will be two major areas of focus based upon two widely used methods of obtaining empirical estimates of demand and supply functions in trade research. These include the direct application of standard econometric techniques and the use of these techniques within the confines of a world trade model. Issues discussed in both of these approaches are relevant to the present study. Consequently, this chapter includes discussion of both approaches, covering major areas of debate within each and relevant empirical applications of the methodologies.

World Trade Model Approach

This approach to estimating demand and supply functions in international trade requires the construction of a model,

within whose structure econometric techniques are used for empirical application. The model contains demand and supply equations for all the major world traders and is built on assumptions which allow for its simplification and self containment.

Within the world trade model approach, there is debate as to whether it is a closer approximation of reality to treat the commodity classes as if they were homogeneous goods or whether the exports within a class produced by different nations should be regarded as different goods. The trade model specification is quite different in the two cases. Given that a major objective of this research is to develop demand models for vegetables which reflect unique characteristics based upon their point of origin, the approach which distinguishes between goods by place of production is that which is of relevance here. In this case, the specification of the demand functions follow Armington's utility tree approach where the total import demand for any good is first determined; this total import demand is then independently allocated among competing sources of supply, or products (Armington,1969). A constrained estimation procedure is used to guarantee that estimated world exports equals world imports.

In Armington's model the distinction between goods and products is an important one. A good denotes a general type of merchandise, for example vegetables, meats, etc. A

product denotes a good manufactured or produced in a particular country or region. Thus U.S. vegetables and Canadian vegetables are two different products, although within the same class of goods. In Armington's model these two products are imperfect substitutes. This is a crucial assumption and one that sets this model apart from many other trade models and theories. It is frequently assumed in international trade theories that merchandise of a certain type supplied by one country is a perfect substitute for merchandise of the same type supplied by any other country. This then implies an infinite elasticity of substitution and constant price ratios between these supplies. This does not follow for Armington's model as products of the same type of good are considered only imperfect substitutes.

Another crucial assumption is that buyer's preferences for different products within any given type of good, U.S. vegetables, Canadian vegetables, are independent of their purchases of products in any other type of good, U.S. meats or Canadian meats, for example. This allows for the measurement of the quantity of each good demanded by each region, or that region's market for that good. Within a region, goods compete in order to determine the sizes of their respective markets. Products compete within these goods' markets in order to determine their market shares. Therefore, the demand for any particular product in any

region can be expressed as a function of the size of the market for that type of good and of the relative prices of the competing products.

Another important assumption is that each region's, or product's, market share of a good's market is unaffected by changes in the size of that market as long as relative prices in the market remain unchanged. With the above assumptions it can be deduced that the size of a good's market is a function of a region's income, or GDP, and the prices of the various goods. Furthermore, the demand for a product is a function of income, prices of each good, and the price of that product relative to the prices of other products in the same market. Or:

$$(3.1)\quad X(i.) = f\{GDP(i), P1, P2, \ldots, Pz\}$$

$$(3.2)\quad X(ij) = f\{X(i.), P(ij) / P(i.)\}$$

where

X(i.) = region i's demand for the good under consideration

X(ij) = demand for product j

i = demanding region
= 1,2,3,...,n
j = supplying region
= 1,2,3,...,n

n = the number of regions in the model

P1,P2,...,Pz = the prices to region 1 of goods 1,2,...,z

P(i.) = the average market price of the good under consideration

z = number of goods considered in the study

GDP(i) = income of region i

Note that the prices of products competing in that region's markets for other types of goods have an influence only in so far as they determine the prices of goods.

The final set of assumptions is made to simplify estimation when there are many sources of supply, that is, many products. These assumptions are that the elasticities of substitution between products competing in any good's market are constant, they do not depend on market shares. Also, the elasticities of substitution between any two products competing in a good's market is the same as that between any other products competing in that good's market.

In Armington's model, there is, for each country or region, a set of demand functions for the products of each region, including the home region (Armington, 1969). Also, for each region there is a supply function for each of its domestically produced products. The regional demand functions for each product are summed to obtain individual product world demand functions. The interaction of the world demand functions with the regional supply function yields the price and quantity of that product. A weighted average of the prices of the products yields the world price of a good. All product producers of a particular good are seen as competitors and the model determines how much of each product is sold where. That is, domestic sales of

products as well as trade flows from every region to every other region are determined by the model.

Armington's model can be used to look at changes in the demand for a product. By differentiating the demand functions the change in the demand for any product can be shown to depend additively on the growth of the market in which it competes and the change in the product's share in that market, where product share changes are dependent upon relative price changes of products in that market. Market growth is dependent upon income changes and the income elasticity of demand for the respective good.

These results provide support to the validity of the modified shares approach to trade forecasting. This approach is often used in trade research and forecasting and consists of two major steps. The first forecasts growth in various markets with a base period matrix. This yields a constant shares matrix for the projection period. The constant shares matrix is then modified to take account of factors which would probably yield gains or losses in shares.

The modified shares methodology was used by Sarris to project changes in world trade of fruits and vegetables with the enlargement of the E.E.C. to include Spain, Portugal and Greece (Sarris,1983). Enlargement would necessarily imply a change in trade barriers to allow Spain, Greece and Portugal to participate in the Common Agricultural Policy, CAP, of the E.E.C.

Sarris' first step was to project world trade in fruits and vegetables with no change in trade barriers, using, however, projections of consumer income for each country. Changes in consumer income result in changed import demand, changed prices and changes in supply patterns, all of which result in a new set of trade patterns.

The second step was to relax the trade barrier assumption. Prices of imports to the E.E.C. from Spain, Greece and Portugal were reduced by an amount calculated to simulate their joining the E.E.C. These price changes resulted in changes in patterns of demand and yielded a projection of post-enlargement trade.

To accomplish his objectives, Sarris used Houthakker and Magee's methodology of obtaining income and price elasticities and Hickman and Lau's methodology of estimating elasticities of substitution (Houthakker and Magee,1969; Hickman and Lau,1973). Houthakker and Magee used a double log specification of demand equations, which they estimated with ordinary least squares. Hickman and Lau used a linear world trade system, generalized to include trend terms, which they showed to be a first order approximation to a theoretical demand function as laid out by Armington. Therefore, the estimated coefficients of the relative price variables can be interpreted as the elasticities of substitution between imports in given markets. In their estimations, import quantities and import and export prices

are taken as exogenous. Consequently, the elasticities of substitution were not estimated in a simultaneous system.

Sarris' work is an empirical application of Armington's theoretical work. The general methodology used, a modified shares approach, was shown by Armington to be a valid method of trade projection when considering demand as distinguished by place of production. The values for the income and price elasticities, as well as the elasticities of substitution were obtained using the methodologies of Houthakker and Magee, and Hickman and Lau, within Armington's theoretical framework. No attempt was made to take account of simultaneity in the system in the estimation of the parameters.

Winters analyzed the manufactured exports of developing countries using an Armington type model (Winters,1984a). He estimated demand and supply equations for manufactured exports using single equation and systems techniques. He also estimated the reduced forms which incorporated all of the explanatory variables of the single equation models, except price, which would be an endogenous variable. Not having to estimate a parameter for price was a strong point for the reduced form as the signs on the price variable were contrary to theoretical expectations for demand and supply in both the single and systems estimations.

The estimation results were disappointing for all three approaches, although the reduced form approach gave the most

plausible results. In the OLS estimations of demand, none of the regressions were statistically significant and the coefficients on relative prices were positive. For supply, again the regressions were not significant and often the coefficients on relative prices were negative. In the systems estimation, the coefficients on relative prices were often positive for demand while negative for supply. Thus, removing simultaneity bias in the parameter estimates did not resolve the sign problem on the price term. The most reasonable results, according to economic theory, obtained in the system estimation approach were for regions of the world with just one country each, or regions dominated by two large countries. Thus aggregation problems may have played a role in the perverse results obtained. The regional aggregations Winters was obliged to use were designed with different purposes than his in mind. It combined very dissimilar countries into the same regions.

Winters, however, attributed the sign problem on the price variable to data inadequacies. His price data were actually unit value data, obtained by dividing total value of the traded commodities by total quantity. Unit value data on aggregated commodities are often correlated with quality. This occurs because the products aggregated into one category are not homogeneous with regard to quality. If sales within the aggregated commodity group shift towards the higher quality product, the unit value, or price, of the

aggregated commodity will go up, although the prices of the individual products have not changed. With an increase in quality levels, it is quite likely that sales will increase. Thus an increase in the price of the aggregated commodity is seen along with an increase in sales; an apparent contradiction to economic theory.

To get around this problem, Winters estimated the reduced form equations where price, being endogeneous, was not one of the explanatory variables. This approach led to the most satisfactory results. The equations fit fairly well and all of the estimates were plausible. Winters concluded that many of the problems with his estimations were a result of having to use unit value data for prices and highly aggregated data, both in terms of commodities and regions.

The significance of Winters' work lies in the fact that he applied simultaneous estimation techniques to a model based on Armington's theoretical approach. Inadequacies of the data obscured any improvement over single equation estimations, but theoretically the system estimations should yield consistent parameter estimates. Single equation techniques used to estimate the demand and supply of traded commodities contain simultaneity bias.

Direct Application of Econometric Techniques

This section will focus on the use of OLS versus a simultaneous technique such as 2SLS or 3SLS, to directly estimate demand and supply parameters in international trade research. The major debate within this approach concerns that of when OLS is preferred to a simultaneous system and vice versa. When using OLS, supply relationships are typically handled by assumption and are not estimated. Generally the assumption is made that the export and import supply price elasticities facing any individual country are infinite. This may be reasonable in the case of the supply of imports to a single country but probably is not for the case of the supply of exports from an individual country. Unless idle capacity exists, or production is subject to constant or increasing returns to scale, it is unlikely that an increase in the world demand for a country's exports can be satisfied without an increase in the price of its exports. The quantity supplied will be a function of the price. Since demand is also a function of price, simultaneity exists. If OLS is used in this case it will yield biased and inconsistent estimators (Goldstein and Khan,1978).

Binkley and McKinzie, 1981, compared the performance of OLS, 2SLS, and analytic 2SLS in the estimation of export demand equations under a variety of circumstances [2]:

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[2]In Binkley and McKinzie's analytic 2SLS, domestic demand

(1) Excess supply shifting more than excess demand

(2) Excess demand shifting more than excess supply

(3) Both curves shifting.

Their conclusions as to which estimator to use were based upon which situation was prevailing. If excess supply was more variable than excess demand, then OLS was the preferred estimator, even if it is biased and inconsistent. Excess supply is domestic supply less domestic demand. The unexplained variation in excess supply, therefore, is the unexplained variation in domestic supply and demand. The variation in excess demand is composed of variation in supply and demand for all other countries. One would expect, in international trade, the variation in excess demand to exceed that in excess supply. If that is indeed the situation, then analytical 2SLS is the preferred estimator while the direct estimation of export demand by 2SLS is acceptable.

Nevertheless, it has been common practice among economists to use OLS in estimating the demand equations for a nation's exports. To compare the results of this type of work to those obtained using a simultaneous approach, Goldstein and Khan estimated demand and supply functions for

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and supply were estimated with 2SLS and the export demand function was obtained by subtraction.

a nation's exports simultaneously (Goldstein and Khan,1978). They did this for eight countries. Their results indicated that export price elasticities of demand are probably considerably larger than those obtained using OLS. However, the estimated income elasticities tended to be very similar. Their results also indicated, using a Koyck-type distributed lag model, that adjustment of exports to changes in the independent variables was neither instantaneous nor very long, usually less than one year.

Because the income elasticities of demand estimated by OLS were very similar to those estimated using simultaneous techniques, conclusions of studies estimating income elasticities of demand using OLS are probably accurate. Houthakker and Magee estimated demand elasticities for both imports and exports with respect to income and price (Houthakker and Magee,1969). Their main emphasis was on the importance of the income elasticity of demand. It has been demonstrated that if trade is initially balanced in a two country model, if prices are constant and if income growth is the same in both countries, then the trade balance between them can still change through time if their respective income elasticities of demand for the other's exports differ (Johnson, 1958).

Houthakker and Magee found that there is a wide disparity between the income elasticities of demand among developed nations for manufactured goods. They also found

that these differences do have a significant effect on international trade, both in terms of direction of trade and balance of payments. Their study focused on U.S. trade in general, with more emphasis on manufactured goods than agricultural products. However, the income elasticity is as equally important in agricultural trade as in trade of manufactured goods. Examination of the differences in income elasticities for vegetables among nations could reveal an underlying force acting on the directions and strengths of trade in that commodity.

Present Study

The present study is a world trade model for fresh vegetables which simultaneously estimates market and product demands , export supply equations, and CIF import prices for each trader. It follows Armington's utility tree approach; total market demand for vegetables within each trading region is determined and independently allocated among competing sources of supply, or vegetable products. Therefore, there are market demands, product demands, export supply equations, and CIF import price equations for all the major world traders contained within the model. Domestic sales of products as well as trade flows from every region to every other region are determined by the model. Estimation of the demand, export supply, and price equations will be done using a simultaneous technique.

Highly aggregated data are used, both for commodities and regions. However, unlike Winters' data, the regions were aggregated specifically for this study. All countries within a region have similar trade patterns in fresh vegetables and face similar trade preferences or barriers. Unit value data are used for prices. These data characteristics may lead to similar problems as those faced by Winters in his study of developing countries' manufactured exports. However, when dealing with international trade, it is very difficult to obtain anything other than highly aggregated commodity data or unit value price data. Also, when estimating a world trade system, it is necessary to aggregate countries into regions in order to make the problem of a reasonable scope.

The use of a systems estimation technique will yield estimated parameters that are less biased than if ordinary least squares was used. Also, the estimated export price elasticities will be much higher than if they were estimated with ordinary least squares. They will be more accurate estimates, according to the study by Goldstein and Khan, and thus any analysis based on these estimates will also be more accurate.

Analysis of the demand parameters will indicate the likely future directions of trade. Estimated price and income elasticities can be used to pinpoint some of the forces operating in world vegetable trade, both currently

and in the past several years. These forces will likely push it in the near future. For example, the price elasticity of demand in the E.E.C. for Mid-Eastern vegetables might currently be considerably lower than that for U.S. vegetables. This would indicate that if both Mid-Eastern and U.S. vegetable exports to the E.E.C. were to increase in price by the same amount, the E.E.C.'s demand for U.S. vegetables would drop more than it would for Mid-Eastern vegetables. Price elasticities can be used to understand the relative effects of price changes on trade patterns. Likewise, income elasticities of demand can be used to understand the relative effects of income changes on trade patterns. Also, as discussed earlier, if income elasticities differ between two countries, their trade balance can change over time even if prices remain constant and income growth is the same in both countries. Income elasticities can give some measure of the relative strengths of demand between countries and some idea of the likely future trends in trade between them.

In summary, a world trade model based on Armington's "Theory of Demand as Distinguished By Place of Production" is constructed for world vegetable trade. It contains market and product demands, export supply equations, and CIF price equations for every major trader. Estimation of the model will be done with a systems methodology, thus eliminating simultaneous equations bias. Results of

estimation can be used to understand the forces driving international trade in vegetables. The parameter estimates can be used to forecast vegetable trade in the near future and to simulate vegetable trade with shocks in the more important exogenous variables such as regional incomes, population levels, production levels, and tariff barriers.

CHAPTER IV

THEORETICAL TRADE MODEL FOR FRESH VEGETABLES

Introduction

In this chapter a simultaneous system for world trade in fresh vegetables will be presented. In the introduction the general approach of the model's construction and implementation are set forth. The second part of the chapter discusses the model's theoretical basis. The third presents the model in a general manner while the fourth section gives the specific functional representation of the system, essential for estimating the complete system. The final section of the chapter discusses implications and uses of the model.

The model is designed to determine the overall demand or market for vegetables in each of the major trading regions, and to measure the allocation of products in these markets from competing suppliers, or to measure product demands and calculate market shares. The approach taken, that of measuring the market demand for vegetables in each major participating region and then allocating these demands to the world vegetable suppliers, is based on the fundamental assumption that products produced in different

regions are distinguishable, they are not perfect substitutes. They do, however, remain within the product group defined as fresh vegetables. Therefore, one region's market for vegetables is likely to be composed of demands for vegetables produced in several distinct regions. The strength of these individual product demand functions is largely determined by the size of the market for vegetables in the demanding region and the price of the product relative to the average vegetable price in the market. The size of each region's vegetable market is affected by many variables with the most important including national incomes, average vegetable prices in the region, population levels, and the prices of substitute goods. This is consistent with basic economic theory which postulates that demand for an agricultural commodity is a function of income, price of the good, population , and the prices of substitute goods. Other variables also affect demand, but they are secondary to these primary variables.

The theoretical groundwork for a model which distinguishes products by place of production was laid by Armington (1969). His work made use of relevant, reasonable assumptions in order to simplify product demand functions which are distinguished by place of production to the point where they could be feasibly estimated. Although simplicity to allow for empirical application was one of his goals, neither Armington nor researchers applying his methodology have fully exploited the potential empirical usefulness of

models which distinguish products by place of production. Thus far, empirical implementation of Armington's work has generally been limited to using single equation estimation techniques (Artus and Rhomberg,1973; Sarris,1983). The exception to this was Winters' study of developing countries' manufactured exports (Winters,1984a). He estimated the demand and supply of these exports using both single equation and systems techniques.

A primary goal of this research is to estimate a world vegetable trade model which distinguishes products according to their region of production using appropriate systems estimation procedures. Given that, in general, demand and supply are determined simultaneously, demands for products distinguished by place of production would be determined simultaneously with their supplies through the price mechanism. Estimation of these demands with single equation techniques would yield biased and inconsistent parameters. Use of a simultaneous, or systems, estimation technique will more fully exploit the mathematical attributes of Armington's theoretical work than would a single equation technique and will yield consistent parameter estimates.

Theoretical Basis of Model

As discussed in the introduction, the theoretical groundwork for the model used in this dissertation was laid

by Armington (1969). In Armington's theoretical framework, the distinction between goods and products is an important one. The term good characterizes a class of items such as vegetables, or meats. A goods category is composed of products which are distinguished by their place of production. The goods category of vegetables used in the world vegetable trading system is composed of those produced by the major vegetable suppliers of the world, Latin America, the United States, Canada, the E.E.C., the Middle East, the Far East, Africa, and the Non-E.E.C. Western European nations. The products within a goods category are not perfect substitutes but are close enough to remain in the same product group.

Armington makes use of two crucial assumptions in order to develop a theory which determines the market demand for a good and allocates it to competing suppliers. First, demands for products within each good's market are independent of those demands for products in other good's markets; thus it is possible to distinguish markets for goods. Second, as long as the prices of products within a goods market remain constant relative to each other, the shares of those products of the total good's market are unaffected by changes in the size of that market. Therefore changes in prices for products in one good's market have no effect on market shares in other goods' markets and the prices of competing goods affect product

demands in other good's markets only indirectly through their influence on the sizes of these markets.

An important issue in a model which distinguishes products by place of production, none of which are perfect substitutes, is the degree of substitutablity which does exist between products. Trade theories and models generally assume that products of the same type produced in different regions are perfect substitutes and therefore have infinite elasticities of substitution. The model used in this analysis, built on Armington's work, assumes that products of the same kind produced in different regions are only imperfectly substitutable. The degree of substitutability must be estimated. With a large number of products, there would be an inordinate number of parameters to be estimated if no limits were placed on their substitutability.

Due to the geometrically increasing number of substitution parameters as the number of regions increases, some limiting assumptions concerning product substitutability are necessary in order to make the model empirically feasible. Armington's theoretical work assumes that the elasticities of substitution between competing products is constant, not dependent on market shares, and that any two products competing in the same good's market have the same elasticities of substitution. Thus there is only one elasticity of substitution for each good's market. These are very restrictive assumptions and can be relaxed

somewhat by assuming that the ratio of the elasticities of substitution for all of the products competing in a good's market must vary by a constant proportion but the substitutability between every product is not necessarily identical (Artus and Rhomberg,1973). Either way, these assumptions impose restrictions on the system which limit the number of parameters to be estimated and greatly facilitate the estimation process.

The validity of the above assumptions depends to a great extent on the differentiability of the products. In the system developed for world vegetable trade, vegetables are distinguished solely by place of production, not by vegetable type. Throughout the model all vegetable types are aggregated into a single vegetable category and vegetable products are distinguished by place of production. This representation of vegetables and vegetable products tends to minimize the potential differentiability which exists among vegetables. However, there are some factors which could lead to marked differences between the vegetable products of the supplying regions, one of the most important being quality levels. Marked quality differentials could exist between vegetables produced in different regions due to production techniques, soil characteristics, and quality control regulations on exports.

Given that the quality levels of vegetable products of the supplying regions could differ, the assumption that all

vegetable products have the same elasticity of substitution is unduly restrictive. A more realistic approach appears to be to assume that the elasticities of substitution between any pair of competing products vary by a constant proportion, but the substitutability between every product is not necessarily identical. This framework would allow for those suppliers who produce unusually high or low quality vegetables and those whose products are distinguishable, but not highly differentiated.

The use of either of these assumptions places specific restrictions on the types of functional forms that can be used. In the case of the first set of assumptions, a constant and uniform elasticity of substitution between competing products, a CES, constant elasticity of substitution, technical relationship is imposed on the system. In the case of the second assumption, a constant ratio of elasticity of substitution between any pair of competing products, without restricting the substitutability to be the same between every product, a CRES, constant ratios of elasticity of substitution , technical relationship is imposed on each vegetable market (Artus and Rhomberg,1973). The imposition and functional nature of these technical relationships determine the functional forms of the product demand and market share functions.[3]

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[3]This is demonstrated quite clearly in part I of the appendix to Armington, 1969.

Generalized Trade System

Before turning to the specific nature of the substitutability among products, it is useful to present the generalized trade system that will be adopted for the current vegetable trade study. Accordingly, a schematic representation is set forth for a two region world with two way trade which illustrates the causal relationships between prices and quantities. The model as presented in this section draws heavily from Armington and Sarris' earlier references. However, unlike their work, the final specified model will be estimated as a simultaneous econometric system of equations.

Initial Schematic Representation

An initial schematic representation of the simple two region model is presented in Figure 4.1. For the sake of clarity only one good, vegetables: two regions, 1 and 2, and two suppliers, 1 and 2, are considered. Let:

X(1.) = the demand for all vegetables in region 1

X(2.) = the demand for all vegetables in region 2

X(.1) = the total supply of vegetables produced in region 1; in this trade system it is constrained to equal world demand for vegetables produced by region 1.

X(.2) = the total supply of vegetables produced in region 2; in this trade system it is constrained to equal world demand for vegetables produced by region 2.

X(11) = the demand in region 1 for vegetables produced in 1

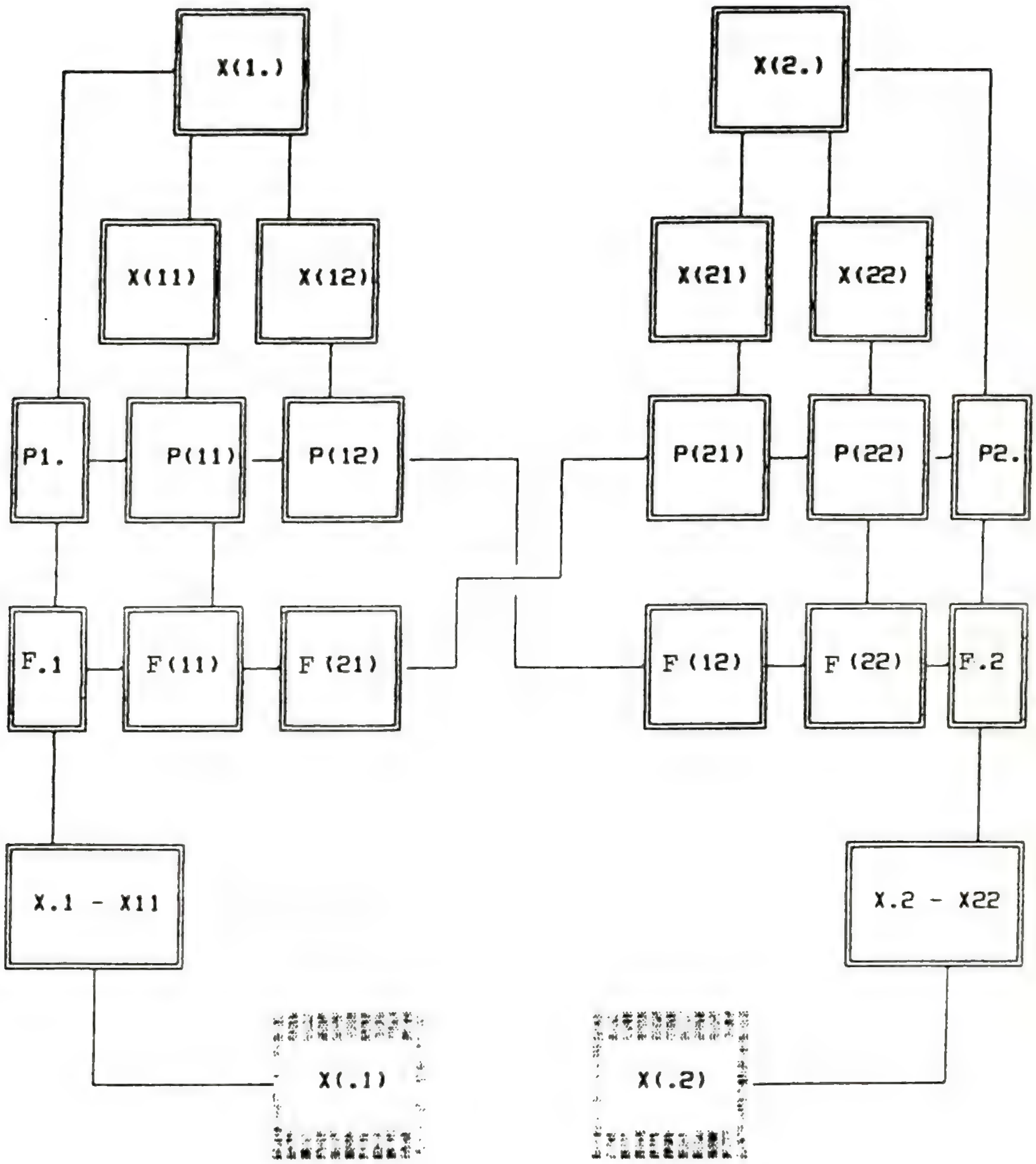

FIGURE 4.1

SCHEMATIC REPRESENTATION OF WORLD TRADE SYSTEM FOR FRESH VEGETABLES.

X(12) = the demand in region 1 for vegetables produced in 2

X(21) = the demand in region 2 for vegetables produced in 1

X(22) = the demand in region 2 for vegetables produced in 2

X(.1) - X(11) = the export supply of vegetables produced in region 1

X(.2) - X(22) = the export supply of vegetables produced in region 2

P(1.) = the average market price paid in region 1 for vegetables

P(2.) = the average market paid in region 2 for vegetables

F(.1) = the average free on board export price for vegetables produced in 1

F(.2) = the average free on board export price for vegetables produced in 2

P(11) = the price in region 1 for vegetables produced in 1. It is assumed to equal the average FOB export price for vegetables produced in region 1.

P(12) = the market price in region 1 for vegetables produced in 2. This price includes the costs of tariffs, non-tariff barriers, preferential treatments, and the costs of insurance and freight.

P(21) = the market price in region 2 for vegetables produced in 1. This price includes the costs of tariffs, non-tariff barriers, preferential treatments, and the costs of insurance and freight.

P(22) = the price in region 2 for vegetables produced in 2. It is assumed to equal the average FOB export price for vegetables produced in region 2.

F(12) = the FOB export price of vegetables produced in region 2 and demanded in 1. It has not been adjusted for tariffs, non-tariff barriers, preferential treatments or the costs of insurance and freight.

F(21) = the FOB export price of vegetables produced in region 1 and demanded in 2. It has not been adjusted for tariffs, non-tariff barriers, preferential treatments, or the costs of insurance and freight.

Figure 4.1 represents a two region world with two way trade. Each of the market demands for the single good, vegetables, X(1.) and X(2.), are filled by the supplies produced by regions 1 and 2; X(11) and X(12) supply region 1's demand for vegetables while X(21) and X(22) supply that of the second region. In this system supply is constrained to equal demand so that the total amounts supplied by regions 1 and 2 equal the total demand for their products, or:

$$X(.1) = X(11) + X(21)$$

and

$$X(.2) = X(12) + X(22).$$

The total supply of a region is assumed to be a function of the previous period's production and is thus exogenous. Export supplies are, however, a function of the average FOB export price and are determined simultaneously by the system. Also, the product being fresh, it is assumed to be non-storable except for short time periods.

Prices are the crucial linking and determining mechanism serving to allocate products so that supplies equal demand on both the product and good level. For each product there is not one relevant price, but seven, all of which are functionally related. Taking X(.2) as an example, the relevant prices are F(.2), P(22), P(2.), P(12), C(12),

F(12), P(1.). The average FOB price of the product, F(.2), is determined by the interaction of region 2's export supply of the product and world demand less domestic demand for X(.2). The CIF regional import prices will differ from F(.2) according to the quality levels of the vegetables sold to each region, the market structure of the import companies, the costs of insurance and freight, and non-tariff barriers. F(12) is the FOB export price of the product produced in region 2 demanded by region 1. C(12) is the price to region 1 after adjusting for all the factors discussed above. Note that the CIF prices are not specifically represented in Figure 1. P(12) is the market price in region 1 for region 2's product. It has been further adjusted to include the costs of tariffs, and preferential treatments. The average price of all products consumed in region 2, imported and domestic, is represented by P(2.); that for region 1 is P(1.). The sizes of the vegetable markets in regions 1 and 2 are heavily influenced by P(2.) and P(1.). Clearly the system is one where demand and supply are determined simultaneously through the price mechanism, with both prices and quantities of products and goods as endogenous variables.

General Functional Representation

Within this framework for trade in fresh vegetables, there are several relationships operating to equilibrate

product and good demand and supply. Their most general functional representations are discussed below; more explicit functional forms will necessitate making assumptions regarding the substitutability between products.

Using i to represent the demanding region and j to represent the supplying region, where i = 1,2,...,8 and j = 1,2,...,8 , so that all regions are included in the specifications, the markets for vegetables, or the good's demand functions, for each region can be represented as:

$$(4.1) \quad X(i.) = f\{ P(i.), GDP(i), Pop(i) \}$$

where

X(i.) = the demand for vegetables in region i

P(i.) = the average market price of vegetables in region i

GDP(i) = the gross domestic product in region i. This is a variable accounting for national income.

Pop(i) = the population of region i. As the population of a region increases, it would be expected that its demand for fresh vegetables would increase.

The general functional nature of (4.1) is a manifestation of the underlying theory; market demands for vegetables are functions of the average vegetable price in the region , income, and population levels.

No specific variable in (4.1) represents the prices of substitute goods. The CPI for the demanding region, CPI(i), could be used for that purpose but it is not for several

reasons. The first is that the CPI is an index for all prices facing the consumer. Agricultural commodities make up a small portion of total consumption in a region. Therefore, use of the CPI would insert a great deal of extraneous information into the system. The second reason is that because the vegetable category being used in this study is highly aggregated, it is likely that any substitute for a particular type of vegetable is found within the aggregation. In general, other types of foods, such as meats and dairy products, are not substitutes for vegetables. The third and final reason is that regional CPIs and populations are highly correlated and population levels are included in the market demand equations. Therefore any explanatory power the CPIs might have is probably captured by the population variables.

Product demand functions are represented as:

$$(4.2) \quad X(ij) = f\{ X(i.), P(ij)/P(i.) \}$$

where

X(ij) = the ith region's demand for vegetables produced in j

P(ij) = the price in the ith market for vegetables produced in j

These product demand functions, represented generally by (4.2), reflect the theory of demand for products distinguished by place of production in that prices for

products in goods' markets other than vegetables can have no effect except through the size of the vegetable markets. Product demands in a particular region are functions of the size of the vegetable market, or good market, and the ratio of the product price to the average vegetable price in that region.

Market share functions, representing the share of a vegetable market supplied by a particular product, can be derived from product demand functions, as illustrated in equation (4.3):

$$(4.3) \quad X(ij)/X(i.) = f\{ P(ij)/P(i.) \}$$

The world vegetable trade system used in this dissertation is constrained to be in equilibrium; demand for vegetable products must equal the supply. This restriction is imposed through:

$$(4.4) \quad X(i.) = \Sigma_j X(ij)$$

$$(4.5) \quad X(.j) = \Sigma_i X(ij)$$

where

X(.j) = the total amount supplied by region j in period t.

Equation (4.4) states that the supply of products in region i, from whatever origin, equals the demand for products in region i. Equation (4.5) imposes the

constraint that the supply of product from j must equal the demand for the product from j. These two sets of equations restrict the system to be in equilibrium; there is no excess demand or supply.

The export supply of a product is assumed to be a function of the average export price of the product and the production level. It is defined as production less domestic demand where production is considered exogenous to the trade system. Export supply is represented as:

$$(4.6)\ X(.j) - X(jj) = f\{F(.j), X(.j)\}$$

where

Domestic demand is defined as:

$$(4.7)\ X(jj) = \{ X(.j) - \Sigma_i X(ij)\}$$

and

F(.j) is the average FOB export price

This specification follows the basic economic theory of an upward sloping supply curve; the amount supplied for export is a positive function of its price.

The average export price of a product is not the price paid by the consumers in the demanding regions. Before reaching the final consuming market, each product incurs insurance and transport costs and perhaps tariff and non-tariff barrier costs. There are several relationships in the model linking export, import, and market prices.

The average free on board, FOB, export price is represented as:

$$(4.8)\ F(.j) = \{\Sigma_i F(ij)X(ij) / X(.j)\} = F(jj)$$

where

F(jj) = the domestic price of product j. A product produced and consumed domestically does not incur costs associated with shipping and barriers to entry. It is therefore assumed to be equal to the average of all FOB export prices for that producing region.

F(ij) = the FOB export price of vegetables produced in region j and demanded in i. It has not been adjusted for tariffs, non-tariff barriers, preferential treatments, or the costs of insurance and freight.

Regional differences in CIF import prices of products due to costs of insurance and freight and other nonquantifiable variables such as quality levels, non-tariff barriers, and market organization of importing companies are accounted for with:

$$(4.9)\ C(ij) = f\{ F(ij), \text{Year} \}$$

where

C(ij) = the import price reflecting the costs of insurance and freight, or the CIF, import price for the product exported from region j to the ith market.

The CIF import prices are adjusted for the costs of tariffs and preferential treatments with:

$$(4.10)\ P(ij) = \{(1 + T(ij))\ C(ij) \}$$

where

T(ij) = the costs of tariffs and preferential treatments between importing to region i and from exporting region j, expressed in percentage terms.

The average prices paid for vegetables in region i is defined as:

$$(4.11)\quad P(i.) = \{\Sigma_j P(ij)\, X(ij)/X(i.)\}$$

Given that this is an international trade model, exchange rates play a role in the allocation process. Depending on the value of a national currency with regards to another, the prices of each of those countries' products to each other will vary. Exchange rates are taken into account in this model by conversion of all price and income data to one currency, the U.S. dollar. The exchange rate of each of the countries' currencies with regard to the U.S. dollar is taken into account on a year by year basis. Thus the yearly price and income data used in the estimation of the model have exchange rate fluctuations built into them. There is no need to explicitly account for exchange rates in the functional forms of the equations.

Specific Functional Representation

Assumptions Regarding Product Substitutability

In order to specify the equations of the simultaneous system in more specific functional forms, assumptions must be made regarding product substitutability. As discussed earlier, the assumption of a constant and equal elasticity of substitution between all products in a market, embedded in the CES function, while being one alternative, may be overly restrictive. Restrictions on the elasticities of substitution which force them to vary by a common, constant proportion, yet allowing for differences in substitutabilities between products within a market, are embedded in the CRES function. These restrictions are reasonable in regards to vegetable trade. Restrictions are placed on product substitutability, reducing the number of parameters to be estimated, and yet some flexibility in substitution is retained. For these reasons, the CRES technical relationship will be imposed on the system. This will be reflected in the functional nature of the product demands. The imposition of the CRES technical relationship determines the functional nature of the product demands and market shares from competing supply regions. The other relationships set forward in the general representation of the trade system, the supply and price relationships, as well as the supply and demand restrictions, are unaffected by the use of the CRES function.

The CRES functional form of the demands or markets for vegetables for each region i and j is represented as:

$$(4.12)\ X(i.) = \{\Sigma_j\ \beta(ij)\ X(ij)^{\alpha(ij)}\ \}^{(1/\alpha(i.))}$$

Given (4.12), it can be shown that the product demand functions are represented as:[4]

$$(4.13)\ X(ij) = \{\ (\ (\ P(ij)/P(i.)\ )^{(1/(\alpha(ij)-1))}\ (\alpha(i.)/\alpha(ij)\ \beta(ij)))^{(1/(\alpha(ij)-1))}\ X(i.)^{((\alpha(i.)-1)/(\alpha(ij)-1))}\}$$

The resulting market share equations are:

$$(4.14)\ X(ij)/X(i.) = \{\ (\ P(ij)/P(i.)\ )^{\pi(ij)}\ (\alpha(i.)/\alpha(ij)\ \beta(ij)\ )^{\pi(ij)}\ X(i.)\}^{(\pi(ij)(\alpha(i.)-1)-1)}$$

where

$$a(ij) = 1\ /\ (1 - \alpha(ij))$$

and

$$\pi(ij) = 1\ /(\alpha(ij) - 1)$$

$\sigma(ij)$ = elasticity of substitution

$$\sigma(ij) = a(ii)\ a(ij)\ /\Sigma_j\ S(ij)\ a(ij)$$

$$S(ij) = P(ij)\ X(ij)\ /\Sigma_j\ P(ij)\ X(ij)$$

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[4]The functional form for the product demand is derived from the CRES market demand in Appendix D. The derivation closely follows that used by Armington for the CES market demand.

$S(ij)$ = value share of the jth product in the ith vegetable market.

The CRES property is clear in that all $\sigma(ij)$ vary proportionately with the common factor of proportion being $1/\Sigma_j S(ij)\, a(ij)$.

Equations (4.13) and (4.14) lay out, specifically, the functional forms of the product demand and market share equations dictated by the imposition of the CRES technical relationship on the markets. The market demand, export supply and CIF product price relationships must also be given specific functional forms. They are each estimated in the double log form. This is chosen for its ease in estimation as well as for its properties. Its first and second derivatives make it suitable for estimating supply, demand, and price relationships. The first derivative with respect to any variable contains the parameter associated with that variable, therefore normally this function would yield downward sloping demand, and upward sloping supply and price relationships. The second derivative can be <, >, or = 1, depending on what the data reveal. This allows for flexibility in terms of the rate of change of the function. Parameters estimated with double log specifications are elasticities. While this imposes the restriction that the elasticities with respect to each individual explanatory variable cannot change, it also allows for ease of interpretation of the estimation results.

Market demands for vegetables are represented as:

$$(4.15)\ X(i.) = \delta(i0)\ P(i.)^{\delta(i1)}\ GDP(i)^{\delta(i2)}\ Pop(i)^{\delta(i3)}$$

Export supply functions for vegetable products are represented by:

$$(4.16)\ X(.j)-X(jj) = \rho(0j)\ P(.j)^{\rho(1j)}\ X(.j)^{\rho(2j)}$$

CIF import prices are represented as:

$$(4.17)\ C(ij) = \Phi(0ij)\ F(ij)^{\Phi(1ij)}\ Year^{\Phi(2ij)}$$

where

$\Phi(0ij)$ captures the costs associated with the distance between regions i and j, as well as the costs associated with non-tariff barriers and the market organization of the importing countries.

$\Phi(1ij)$ measures directly the strength of the relationship between the CIF import price and the FOB export price

$\Phi(2ij)$ allows the costs of insurance and freight to vary on a yearly basis.

The other price relationships and equilibrium restrictions retain the same functional forms as those presented in the generalized specification.

The entire system has been specified and is repeated here in its entirety.

Market Demands

$$(4.15)\ X(i.) = \delta(i0)\ P(i.)^{\delta(i1)}\ GDP(i)^{\delta(i2)}\ Pop(i)^{\delta(i3)}$$

Product Demands

$$(4.13)\ X(ij) = \{ ((P(ij) / P(i.))^{(1/(\alpha(ij)-1))} (\alpha(i.) / \alpha(ij)\beta(ij)))^{(1/(\alpha(ij)-1))} X(i.)^{((\alpha(i.) -1)/(\alpha(ij)-1))} \}$$

Average Market Price

$$(4.11)\ P(i.) = \{\Sigma_j P(ij)X(ij) / X(i.) \}$$

Market Price for Products

$$(4.12)\ P(ij) = \{ (1 + T(ij)) C(ij) \}$$

CIF Import Price

$$(4.17)\ C(ij) = \Phi(0ij)\ F(ij)^{\Phi(1ij)}\ Year^{\Phi(2ij)}$$

Average Export Price

$$(4.8)\ F(.j) = \{\Sigma_i F(ij)\ X(ij) / X(.j) \}$$

Demand Restriction

$$(4.4)\ X(i.) = \Sigma_j X(ij)$$

Supply Restriction

$$(4.5)\ X(.j) = \Sigma_i X(ij)$$

Domestic Demand

$$(4.7)\ X(jj) = \{ X(.j) - \Sigma_i X(ij) \}$$

Export Supply

$$(4.6)\ X(.j)-X(jj) = \rho(0j)\ F(.j)^{\rho(1j)}\ X(.j)^{\rho(2j)}$$

System as Specified for Estimation

The system for trade in fresh vegetables as specified in this study is nonlinear. Many of the equations are multiplicative or raised to powers, or both. For estimation purposes it would be advantageous to convert the system, or at least part of it, to a linear form. The functional

relationships, that is the market demands, product demands, export supplies, and the relationship between FOB and CIF prices can and will be expressed linearly for the purposes of estimation. This is done by working in logs. The identities, that is, domestic demands, the demand and supply restrictions, market prices, average market prices, and average export prices will be left in their nonlinear forms. Thus the system as specified for econometric estimation purposes is as follows, with the functional relationships presented first and then the identities.

Market Demands

$$(4.18)\ \log X(i.) = \log \delta(i0) + \delta(i1) \log P(i.) + \delta(i2) \log GDP(i) + \delta(i3) \log Pop(i)$$

Product Demands

$$(4.19)\ \log X(ij) = \log \phi(0ij) + \phi(1ij) (\log P(ij) - \log P(i.)) + \phi(2ij) \log X(i.)$$

where

$$\phi(0ij) = \{(\alpha(i.) / \{\alpha(ij)\ \beta(ij))^{(1/(\alpha(ij)-1))}\}$$

$$\phi(1ij) = \{1/(\alpha(ij)-1)\}$$

$$\phi(2ij) = \{(\alpha(i.)-1)/(\alpha(ij)-1)\}$$

Export Supply

$$(4.20)\ \log (X(.j) - X(jj)) = \log \rho(0j) + \rho(1j) \log F(.j) + \rho(2j) \log X(.j)$$

CIF Import Price

$$(4.21)\ \log C(ij) = \log \Phi(0ij) + \Phi(1ij) \log F(ij) + \Phi(2ij) \log Year$$

Average Market Price

$$(4.11)\ P(i.) = \{\Sigma_j\ P(ij)X(ij)\ /\ X(i.)\ \}$$

Average FOB Export Price

$$(4.8)\ F(.j) = \{\Sigma_i\ F(ij)X(ij)\ /\ X(.j)\ \}$$

Market Price

$$(4.10)\ P(ij) = \{\ 1 + T(ij)\ )\ C(ij)\ \}$$

Demand Restriction

$$(4.4)\ X(i.) = \Sigma_j\ X(ij)$$

Supply Restriction

$$(4.5)\ X(.j) = \Sigma_i\ X(ij)$$

Domestic Demand

$$(4.7)\ X(jj) = \{X(.j) - \Sigma_i\ X(ij)\ \}$$

The i and j subscripts on each of the equations are used to denote the regions of demand and supply, respectively.

The use of a simultaneous system to estimate the parameters of the model will yield consistent parameter estimates for the explanatory variables. The estimates of the intercept terms, however, will be biased. A look at the market demand function will clarify this. Market demand functions are represented in this study as:

$$(4.18)\ \log X(i.) = \log \delta(i0) + \delta(i2) \log P(i.) + \delta(i2) \log GDP(i) + \delta(i3) \log Pop(i)$$

The intercept term, $\delta(i0)$, is estimated in the regression analysis as $\delta^*(i0)$. The estimator of the intercept is,

however, actually $\delta(i0) = \text{antilog } \delta^*(i0)$. While $\delta^*(i0)$ retains all the desireable properties from $\delta(i0)$, its small sample properties, in particular its unbiasedness, do not carry over to $\delta^*(i0)$. This is true of the intercept terms in the product demand, export supply, and CIF import price functions as well (Gujarati,1978). The main focus of the study is, however, to examine how the dependent variables are related to the independent variables. The intercept terms are of secondary importance and it is not necessary to obtain unbiased estimates of them.

Implications

Estimation of the trade model described will yield consistent estimates of the parameters in the market demand, product demand, export supply, and the CIF import price equations for the years 1962-1982 for all the major participants in vegetable trade. These parameters will measure the strength of the influence of the average price of vegetables in the region, income, and population levels on the market demands for fresh vegetables. Also on the demand side, they will yield a measure of the substitutability between vegetable products within each market. On the supply side, the parameters will measure the strength of the relationship between export supply levels and the average export price for that region. The relationship between the FOB product export price and the

CIF product import price will be measured, as well as that between the CIF import product price and year. These will all yield insights into the strength of the relationships and forces which drive international trade of fresh vegetables.

The model can, and will, be used to examine the impact of external changes in the world vegetable trading environment. For instance, if the E.E.C. were to lower its tariffs on imported vegetables, the impact on the major vegetable trading regions could be estimated. Clearly a model such as this would be very useful during trade negotiations. The model could also assess the impacts of the strong dollar on international vegetable trade, giving U.S. government policy makers some measure of the extent of the damage to U.S. vegetable producers caused by the strong dollar. As another example, if one of the major suppliers had some type of natural disaster, wiping out the bulk of its crop, the impact on the world vegetable trading situation could be assessed. In short, any of the independent variables of the system could be shocked and their impact on the world vegetable trading situation assessed. This can yield important insights into the major factors driving world vegetable trade, both currently and in the past twenty-five years, and insights into what policies to follow in order to maximize the United States' and Florida's participation in and benefits from international vegetable trade.

CHAPTER V

ECONOMETRIC ISSUES

Introduction

Chapters 1,2,3, and 4 laid out the scope of the dissertation by identifying the relevant economic issues in international trade, discussing the trends evident in fresh vegetable trade, reviewing the pertinent literature, and designing an economic model for use in examining world vegetable trade. The purpose of this chapter is to discuss the econometric issues which are relevant in the estimation of the parameters of the model. Accordingly, in this chapter, the trade model is presented in matrix algebra, there is a discussion of nonlinear simultaneous systems and problems encountered in their estimation, including the identification problem. The identifiability of the equations of the trade system is determined and there is a discussion of the procedures available for estimating nonlinear simultaneous systems. The most appropriate estimation technique for the world trade system in vegetables from a theoretical standpoint is discussed and data issues are considered. The last section summarizes the discussion of the chapter and gives some insight as to

questions the empirical results, discussed in the next chapter, may answer.

Trade Model in Matrix Algebra

The matrix algebra representation of the trade model used in this study to examine international trade in fresh vegetables is laid out below. The i and j subscripts represent regions of demand and supply, respectively, and both go from 1 to 8, reflecting the fact that there are eight regions which are major traders in fresh vegetables.

Because the system is simultaneous and the supply and demand restrictions do not allow for any excess supply or demand, it is not necessary to estimate product demands and CIF import product price equations for every possible trade linkage between i and j in the system. Therefore, for each region, only six product demands and seven CIF import product prices, as opposed to eight of each, are estimated. Demand for domestically produced vegetables is defined to be total regional consumption less imports and is not estimated, since that remaining demand can be calculated using the estimated equations and the identities. One other product demand per region is not estimated, it does not matter which one. For ease in writing the SAS program, this second product demand determined by default is defined to be the region specified by the demanding region's numerical specification, plus one. Thus, no Latin American

product demand for U.S. vegetables is estimated, no U.S. demand for Canadian vegetables is estimated, and so forth. In terms of product prices, the domestic market price is defined to be equal to the average export price. There is no need to estimate a CIF product price for the domestically produced product as it is not imported. The dimensions of the matrices in the matrix algebra reflect this characteristic of the system and only include equations for those variables actually estimated econometrically.

The system is represented in matrix algebra as follows:

(5.1) $[0\ \Gamma]\ \underline{Y} + [0\ \xi]\ \underline{W} + [0\ \Omega]\ \underline{Z} + [0\ I]\ \underline{U} = 0$

(5.2) $K(Y) + H(Z) = 0$

(5.3) $Y(T) = L(Y)$

(5.4) $Z(T) = L(Z)$

or, in general,

(5.5) $f(\ \underline{Y,W,Z,U}\ )=0$

where

Yi = column vector of endogenous variables for region i

Yi' = [X(i.) X(ij) P(i.) P(ij) C(ij) F(ij) F(.j) X(.j)-X(jj)]

Yi' is a 30 x 1 vector

Y is a column vector componsed of Yi' where i = 1,2,3,4,5,6,7,8

Y is a 240 x 1 vector

Y(T) = column vector of log transformed endogenous variables

Y(T) is also a 240 x 1 vector.

$\underline{Y}$ = column vector composed of Y and Y(T)

$\underline{Y}$ is a 480 x 1 vector

W = column vector of nonregionally specific exogenous variables

W' = [1 Year]

W is a 2 x 1 vector

W(T) is a log transformation of W

W(T) is also a 2 x 1 vector

$\underline{W}$ = column vector composed of W and W(T)

$\underline{W}$ is a 4 x 1 column vector

Zi = column vector of exogenous variables for region i

Zi = [GDP(i) Pop(i) T(ij) Prd(j)]

Zi is a 10 x 1 vector

Z = column vector of exogenous variables which are regionally specific for all 8 regions

Z is an 80 x 1 vector

Z(T) = column vector of log transformed exogenous variables

Z(T) is also an 80 x 1 vector

$\underline{Z}$ = column vector composed of Z and Z(T)

$\underline{Z}$ is a 160 x 1 vector

U = column vector of error terms for original nonlinear equations

U is a 120 x 1 vector

U(T) = column vector of error terms for double log functional forms

U(T) is also a 120 x 1 vector

$\underline{U}$ = [U U(T)]

$\underline{U}$ is a 240 x 1 vector

$\Gamma(i)$ = matrix of parameters on the log transformed endogenous variables for region i

$\Gamma(i)$ is a 15 x 30 matrix (see Table 5.1)

Γ = block diagonal matrix of parameters on endogenous variables for all eight regions

Γ is a 120 x 240 matrix

$$\Gamma = \begin{bmatrix} \Gamma 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \Gamma 2 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \Gamma 3 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \Gamma 4 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \Gamma 5 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \Gamma 6 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \Gamma 7 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & \Gamma 8 \end{bmatrix}$$

$\xi(i)$ = matrix of parameters on the log transformed non-regionally specific exogenous variables

$\xi(i)$ is a 15 x 2 matrix

$$\xi(i) = \begin{bmatrix} \delta(0i) & 0 \\ \phi(0i1) & 0 \\ \phi(0i2) & 0 \\ \phi(0i3) & 0 \\ \phi(0i4) & 0 \\ \phi(0i5) & 0 \\ \phi(0i6) & 0 \\ \Phi(0i1) & \Phi(2i1) \\ \Phi(0i2) & \Phi(2i2) \\ \Phi(0i3) & \Phi(2i3) \\ \Phi(0i4) & \Phi(2i4) \\ \Phi(0i5) & \Phi(2i5) \\ \Phi(0i6) & \Phi(2i6) \\ \Phi(0i7) & \Phi(2i7) \\ \delta(0i) & 0 \end{bmatrix}$$

TABLE 5.1

COMPOSITION OF $\Gamma(i)$, THE MATRIX OF PARAMETERS ON THE LOG TRANSFORMED ENDOGENOUS VARIABLES FOR REGION i.

-1	0	0	0	0	0	0	δ_{i1}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ϕ_{2i1}	-1	0	0	0	0	0	$-\phi_{1i1}$	ϕ_{1i1}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ϕ_{2i2}	0	-1	0	0	0	0	$-\phi_{1i2}$	0	ϕ_{2i2}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ϕ_{2i3}	0	0	-1	0	0	0	$-\phi_{1i3}$	0	0	ϕ_{1i3}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ϕ_{2i4}	0	0	0	-1	0	0	$-\phi_{1i4}$	0	0	0	ϕ_{2i1}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ϕ_{2i5}	0	0	0	0	-1	0	$-\phi_{1i5}$	0	0	0	0	ϕ_{1i5}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
ϕ_{2i6}	0	0	0	0	0	-1	$-\phi_{1i6}$	0	0	0	0	0	ϕ_{1i6}	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	ϕ_{i1}	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	ϕ_{i2}	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	ϕ_{i3}	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	ϕ_{i4}	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	ϕ_{i5}	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	ϕ_{i6}	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	0	0	0	0	0	0	0	ϕ_{i7}	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	$\rho_{.i}$	-1

ξ = matrix of parameters on the log transformed non-regionally specific exogenous variables for all eight regions

$$\xi = \begin{bmatrix} \xi 1 \\ \xi 2 \\ \xi 3 \\ \xi 4 \\ \xi 5 \\ \xi 6 \\ \xi 7 \\ \xi 8 \end{bmatrix}$$

ξ is a 120 x 2 matrix

$\Omega(i)$ = matrix of parameters on the log transformed regionally specific exogenous variables for region i

$\Omega(i)$ is a 15 x 10 matrix

$$\Omega(i) = \begin{bmatrix} \delta(i2) & \delta(i2) & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & \rho(2j) \end{bmatrix}$$

Ω = block diagonal matrix of parameters on the log transformed regionally specific exogenous variables for all eight regions

Ω is a 120 x 80 matrix

$$\Omega = \begin{bmatrix} \Omega 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & \Omega 2 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & \Omega 3 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & \Omega 4 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & \Omega 5 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & \Omega 6 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & \Omega 7 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & \Omega 8 \end{bmatrix}$$

K(Y) = transformations of the endogenous variables needed for the identities

H(Z) = transformations of the regionally specific exogenous variables needed for the identities

The log linear functional relationships are expressed in (5.1). There are 120 estimated equations which are represented by (5.1), 15 per region. These include one market demand, six product demands, seven CIF product prices, and one export supply, per region. The identities are represented by (5.2), and the log transformations by (5.3) and (5.4). This system, after the transformations, is linear in all parameters as shown with (5.1), but nonlinear in the identities. The system is then represented, in (5.5), by the general function which includes both linear and nonlinear equations.[5]

This is a nonlinear simultaneous system. Prices and quantities at all levels of the system are estimated simultaneously for each of the major traders. The equations above specify the structural form of the model.

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[5]The system presented in Chapter IV is a somewhat simplified version of that actually estimated. See Appendix G for the final estimated model. The matrix algebra represents the equations actually estimated.

Methods of Estimating Nonlinear Simultaneous Systems

While structural equations represent postulated behavior in the marketplace, they also allow endogenous variables to be functions of other endogenous variables. In simultaneous systems this leads to an estimation problem since some right hand variables in any one equation will not be independent of the error term. Ordinary least squares estimation of the structural parameters will then be inconsistent since the assumption that the expected value of the error term equals zero is no longer true. Such problems are typically solved with simultaneous estimation techniques.

The reduced form of the model is obtained when the endogenous variables are expressed as functions of only exogenous variables. If all the equations are just identified, that is, if one can uniquely calculate the structural parameters from the reduced form parameters, then indirect least squares is an option for estimation of the system. ILS estimates the reduced form equations with OLS and then calculates the structural parameters from these. The estimated parameters are consistent. If one or more equations are overidentified, then structural parameters cannot be uniquely determined from reduced form parameters and some other estimation technique is necessary.

Two and three stage least squares provide alternatives for dealing with over identified systems. Both of these are

instrumental variable techniques, where instrumental variables, which are not correlated with the regression disturbance but which are highly correlated with the regressors, are found for each of the endogenous variables which act as regressors in the functional specifications for each of the endogenous variables. Typically, to create the instrumental variables, the endogenous variables are regressed on all of the exogenous variables of the system. The resulting instrumental variables are used as surrogates for the endogenous variables that are included as right hand variables in the initial structural equations.

Creating instrumental variables in this manner uses a degree of freedom for each exogenous variable in the system. The data for this study have twenty-one observations, or twenty-one degrees of freedom, and eighty-two exogenous variables. If a standard instrumental variables technique were used to estimate this system, the degrees of freedom would be exhausted before any instrumental variables were created.

In order to circumvent this problem, the method of principal components can be used. This method calculates linear combinations of the exogenous explanatory variables, principal components, such that as much of the variation in the explanatory variables as possible is captured by a subset of the principal components. As many principal components as explanatory variables used to compute them are

calculated. The principal components are then used in the estimation process in lieu of instrumental variables. However, not all principal components are used since a small subset of principal components can usually account for most of the variation in the original explanatory variables.

The use of instrumental variables, created either by regressing each of the endogenous variables on all of the exogenous variables or by the method of principal components, removes the problem of correlation between error terms and regressors. It is quite possible, however, that error terms across equations are correlated due to some external event which affected fresh vegetable trade world wide. This type of correlation is accounted for with the third stage estimates. Both 2SLS and 3SLS yield consistent estimates; 3SLS is more efficient because it does take into account the correlation of the structural disturbances across equations.

The small sample properties of unbiasedness and minimum variance are violated with both 2SLS and 3SLS. Because of this, calculated t statistics will not be precisely accurate. Therefore, conclusions regarding the significance or insignificance of estimated parameters can only be made on a tentative basis.

Determining Identifiability of Equations in Simultaneous Systems

There are two general rules used for determining the identifiability of an equation in a simultaneous system. These are the order and rank conditions. Both of these make use of prior information regarding the variables of the model in order to determine the identifiability of an equation. Specifically, they draw on restrictions in the form of zero coefficients on the variables. The order condition states that for an equation to be identified, there must be at least G-1 variables excluded from the equation, where G is the number of endogenous variables in the system. In the rank condition, the rank of a matrix composed of all of the equations of the system other than the one whose identifiability is under question is computed. There are as many columns as excluded variables in the equation under question and as many rows as other equations in the system. Coefficients of 0 and 1, for excluded and included, are assigned to the variables according to their presence, or lack thereof, in each of the equations. This implies that if the rank of that matrix is equal to G-1, the equation is identified. If it is less than G-1, it is underidentified and if it is greater than G-1 it is overidentified.

The order condition is a simplification of the rank condition. It is necessary but not sufficient because one

or more variables may be linear combinations of others, in which case the order condition would not give an accurate reflection of the number of included and excluded variables. The rank condition, however, is necessary and sufficient because, in computing the rank of a matrix, variables which are linear combinations of others are not considered.

Identifiability of Equations in the System for World Vegetable Trade

There are ten types of relationships for each region in the vegetable trade system as specified (see Chapter IV). Six of these are identities, which are always just identified. The identifiability of the other four types needs to be determined. These are the market demands, product demands, CIF import prices, and export supplies. Repeating these four functional relationships as they were stated in Chapter IV in equations (4.18), (4.19), (4.20), and (4.21):

Market Demand

$$(5.6)\ \log X(i.) = \log \rho(i0) + \rho(1) \log P(i.) + \rho(i2) \log GDP(i) + \rho(i3) \log Pop(i)$$

Product Demand

$$(5.7)\ \log X(ij) = \log \phi(0ij) + \phi(1ij) \log P(ij) - \phi(1ij) \log P(i.) + \phi(2ij) \log X(i.)$$

CIF Import Price

$$(5.8)\ \log C(ij) = \log \Phi(0ij) + \Phi(1ij) \log F(ij) + \Phi(2ij) \log Year$$

Export Supply

$$(5.9)\ \log [\ X(.j) - X(jj)\ ] = \log \delta(0j) + \delta(1j) \log P(.j) + \delta(2j) \log X(.j)$$

The subscripts i and j represent regions of demand and supply, respectively, and each go from 1 to 8. Given that each combination of subscripts on each type of variable represents a different variable, there are a large number of variables. These were presented in the matrix representation earlier in this chapter. When all trade possibilities are accounted for, there are 490 variables, 408 of which are endogenous and eighty-two of which are exogenous.[6]

To restate the order condition, for an equation to be identified, it must exclude at least G-1, or 407 variables in this system, to be identified. Therefore, in order for any equation in this model to be underidentified it would have to contain more than eighty-three variables. Looking at each of the four relationships for each region under consideration, it is clear that they do not contain anywhere

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[6]The numbers of endogenous and exogenous variables reflect those used in the actual econometric estimation. This system is somewhat more complex than that presented in Chapter IV. Consequently there are a few more variables than specified in the simpler version of Chapter IV. See Appendix G for the specific model estimated.

near that number of variables. The market demand equation contains four variables, the product demand four, the CIF import price equation three, the export supply, four variables. They exclude 404 endogenous, 404, 405, and 404 variables respectively. They are all overidentified. Since they are overidentified, a systems estimation technique is called for. Given that the demand and export supply equations are being estimated for the same time period for all traders, it is likely that at least some significant events external to the vegetable markets affected all traders and, therefore some covariablility in the errors across equations is expected. This implies that 3SLS is the appropriate estimation technique. The nonlinearities present in the restrictions of the system dictate that a nonlinear estimation technique be used (see Chapter IV). Thus, from a theoretical standpoint, it appears that the most appropriate methodology to use in estimating the parameters for this world trade system for vegetables is nonlinear 3SLS, with principal components as instrumental variables.

Statistical Analysis System (SAS) Estimation of Nonlinear Simultaneous Systems

SAS can be used to estimate the parameters of nonlinear simultaneous systems as well as simulate the effects on the system of changes in exogenous variables. Three procedures are included in the SAS/ETS nonlinear modeling system. They

are SYSNLIN, which estimates the parameters of the model, SIMNLIN, which simulates or forecasts the model, and MODEL, which is a model utility procedure which compiles and stores a model program for later use by SYSNLIN or SIMNLIN.

SYSNLIN combines iterative minimization methods for nonlinear regression with estimation techniques designed for simultaneous systems to estimate parameters in a simultaneous system of nonlinear equations. All of the methods used by SYSNLIN minimize an objective function composed of a generalized sum of squares. This sum of squares is represented as:

(5.10) U'(s ' x w)U / n,

where

U is the ng x 1 vector of residuals for the g equations

U = [U1 U2 U3 ... Ug]'

U is a 2520 x 1 column vector

s is a g x g matrix that estimates the covariances of the errors across equations

s is a 120 x 120 matrix

w is an n x n matrix composed of the projection matrix for instruments,z

w = z(z'z)z'

w is a 21 x 21 matrix

z is an n x k matrix of instruments

z is a 21 x 87 matrix

n is the number of nonmissing observations

n = 21

It is assumed that the equation errors for each observation are identically and independently distributed with a zero mean vector and positive definite covariance matrix consistently estimated by s. There are no other assumptions concerning the distribution of the errors and they need not be normally distributed.

The estimators obtained with SYSNLIN are consistent, however, for nonlinear systems small sample properties may not be good. The tests and standard errors reported are based on the convergence of the distribution of the estimates to normal distribution in large samples (SAS/ETS User's Guide, 1984). The data which will be used to estimate the world trade system for fresh vegetables have twenty-one observations. Because this is a small sample, the standard errors are likely to be biased downwards and the estimated parameters upwards. Nevertheless, the state of the art of econometrics is such that estimation with a nonlinear simultaneous methodology is the most efficient and unbiased method available for complex supply and demand phenomena.

Data Sets

Introduction

There are four major data sets used in this study, trade, financial, production, and tariff levels. The first three were originally obtained on a country level and aggregated up to a regional level. The trade data were obtained from a United Nations tape. This tape includes import and export quantity and value data for the SIC code 054, fresh vegetables, for the years 1962-1984. From these import and export prices per unit were calculated. The financial data were obtained from an International Financial Statistics tape. The statistics from that tape used in this study are the GDPs, CPIs, exchange rates, and population levels. The production levels of fresh vegetables were obtained from an FAO tape. The financial and production data also cover the years 1962-1984. The tariff levels were obtained from various sources. These were the most difficult data to obtain. Manipulations were carried out on these data sets, after which they were merged to create the final data set, which is in a format suitable for estimation of the vegetable trade system.

Trade Data

The trade data were originally organized by country and partner country for both quantities and values for exports

and imports. Quantities are measured in metric tons and values in thousands of U.S. dollars. The country is the importer or exporter and the partner is who was imported to or exported from. Because all countries and partner countries are included in both the import and export data, all of the trade information is contained in each and the two groups of data should be duplicates. In fact, they are not identical but are close to being so. Discrepancies could be due to any number of causes including poor infrastructure for recording trade data and an exporter reporting exports in one year while the importer reporting the same transaction in the following year. It is likely that both of these are important in explaining the discrepancies in the U.N. trade data. Evidence for this comes from the patterns of the discrepancies. The countries with the most and largest discrepancies between the two presentations of data are those which are underdeveloped and where there is little emphasis on and poor infrastructure to facilitate the collection and recording of data. However, even in countries where data collection is given a high priority, such as the U.S. and Canada, there is discrepancy between the import and export data.

There were quite a few missing data points on the U.N. trade tape. Estimation of an econometric system on a data set with missing data will result in the entire observation in which the missing data are contained being thrown out.

With only twenty-one observations, it is crucial to use all of the available data. Therefore any missing data points were approximated before the creation of the final data set, with the method of approximation differing depending on the type of data.

The import side of the trade data was the more complete. Therefore the decision was made to use this data to represent both imports and exports. As both countries and partner countries are represented in the data, obtaining exports from import data was simply a matter of reversing the country of origin and partner. Quantities in the import data that were missing were filled in with export data. Quantities which were not available from either import or export data were approximated through interpolation.

Both the import and export data were used to calculate import and export prices per unit, where the unit of measurement is metric tons. For these, quantities and values on both the import and export side were needed as quantities can be substituted from one data set to another, but values cannot; imports are measured CIF and exports FOB. Therefore, if values were missing, prices were missing. In order to deal with missing prices on the export side, the average regional export price was used for a missing product price. In that way it was not necessary to approximate levels for missing export quantities or values, of which there were several. On the import side a more complex procedure was followed. Import product prices

were regressed on their export product prices for all of the years of the data. The estimated relationship was then used to estimate an import product price for a year when it was missing.

Financial Data

Financial data were obtained from an International Financial Statistics tape. The data were arranged on a country by country basis and contain GDPs, CPIs, exchange rates in national currencies per U.S. dollar, and population levels, by year.

The unit of measurement of the GDPs was always the national currency, although there was no consistency as to whether they were measured in millions or billions. Before the GDP data could be used in estimation of the model, they had to be put into a consistent level of measurement, converted to U.S. dollars, and summed to obtain regional GDPs. The conversion was accomplished by dividing the GDPs, in billions of national currencies, by the exchange rates of the national currencies to the U.S. dollar. The aggregation into regional GDPs was a straightforward summation of national GDPs measured in U.S. dollars.

Although all national CPIs are contained in the data, the only ones used were those of the U.S. and were on a 1970 basis. Because the years covered in the study are 1962 through 1982, the U.S. yearly CPIs were converted to a 1962

basis in order to be more clearly related to the time frame of the study. These yearly CPIs were then used to deflate all regional GDPs so that, not only were they all in U.S. dollars, but they were measured in 1962 U.S. dollars. Regional average market prices were deflated, in the estimation of the model, by the U.S. yearly CPIs. In the data set the average market prices remain undeflated. There was no need to deflate product prices because they enter the model as a ratio to the average market price. Deflating both by the yearly CPIs would yield no change in the ratio.

Trade, Financial, and Production Data Merged

The trade data were merged with the financial and production data by year and region. This merged data set contains the exogenous variables year, production levels, all national CPIs, including those of the U.S. on a 1962 basis, GDPs in U.S. dollars, and exchange rates in national currency per U.S. dollar for each region. The endogenous variables include product import quantities and prices and product export prices. Thus this merged data set contains all the information necessary for estimation with the exception of tariff levels. The years included are 1962 to 1984. However, the 1983 and 1984 trade data are not consistent with trends observed in the previous years and could not be confirmed by other data sources. Therefore the decision was made to use only data from 1962 to 1982 in the creation of the final data set.

Tariffs

In order to operationalize the model, tariff policies of the major traders are needed. These are necessary for the price linkage equations. It was not possible to obtain these all from the same source, indeed it was often difficult to obtain them at all. There is, apparently, no single U.S. government office or bureau responsible for obtaining and updating tariff schedules for the countries of the world, including the United States. The search for the tariff information used in this dissertation included calling several conceivably useful offices in the U.S. Department of Agriculture, several of the major libraries including the Library of Congress, the U.S. Customs Office in Washington, D. C., as well as searching out possibly useful documents available at the University of Florida. These efforts were able to yield tariff schedules for the U.S., Canada, and Japan for several of the years covered in this dissertation. Specific tariff schedules for the E.E.C. and Non-E.E.C. Western European region were not available nor were any for Latin America or Africa. The sources for the European regions were mostly journal articles in which their tariff rates for trade with various partners were published. Latin America and Africa were assumed to be free of tariffs since none of the available journal articles and Foreign Agricultural Service references to their vegetable

trade mentioned any tariff barriers. In general, tariff barriers are not a major policy instrument by which the Middle East controls its imports of fresh vegetables. Therefore, it too was assumed free of tariffs. Appendix E lists the tariffs used to estimate the world vegetable trade system.

All available information was used to formulate the tariff rates imposed on the system. For the United States that included U.S. Customs, Tariffs, and Trade which lists vegetables by type with their tariff rate for 1965, 1970, 1972, 1973, and 1982, History of the Tariff Schedules of the U.S., Annotated which gives the rates for individual vegetables for the years 1968-1987, Tariff Schedules of the U.S., Annotated which gives 1985 tariff rates, and Comparative Tariffs and Trade. This last source compares U.S. and E.E.C. rates of duty by individual commodity for 1963 and was used in formulating tariffs for the U.S. and the E.E.C. In deciding on the tariff levels to impose on vegetables imported to the U.S.in the trade model, all of these sources were examined as to the general level of tariff protection on vegetables in the years of the study. All regions were afforded equal treatment by the U.S., essentially all were given most favored nation status. This was true in assigning tariffs to all traders except the E.E.C., which clearly gives preferential treatment to some nations or regions.

In deciding on a tariff level for the Canadian market, Tariffs on Selected Agricultural Products was the primary source. It lists tariff rates for individual fresh vegetables for 1980 and also gives a historical listing of the tariff rates by commodity. The years included go from the 1930's to the late 1970's.

Tariff information for Japan was the easiest to obtain. The Foreign Agricultural Service, International Trade Policy Division furnished the Customs Tariff Schedules of Japan for several of the years spanned by this study. The exact years are listed in the references. Japan is, however, only one country included in the Far Eastern region. Descriptions of the protective policies of the other countries in the region are found in "Southeast Asia: Sales Opportunities For U.S. Fruits and Vegetables." These two sources were used to formulate a tariff rate for the Middle Eastern region.

The tariffs listed for the E.E.C. were decided upon through reference to Comparative Tariffs and Trade and The Official Journal of the E.E.C.,1984 , which both list individual fresh vegetables and their rates of duty, "World Trade in Fruits and Vegetables" which lists weighted tariff rates for 1974 and 1978 on E.E.C. imports of vegetables from countries with which the E.E.C. has a preferential arrangement, and "An Evaluation of the CAP as a Barrier Facing Agricultural Exports to the E.C." which lists tariffs on fruits and vegetables as a group. The decisions as to

which regions to give preferential treatment to were reached through these same sources and The Common Agricultural Policy of the European Community and The E.E.C.'s Generalized Scheme of Preferences and the Yaounde' and Other Agreements.

The above sources were also used to formulate a tariff level for the Non-E.E.C. Western European region. Basically this level was reached by observing those used by the E.E.C. over the years and understanding the differing situations of the two regions. The E.E.C. is protecting its domestic producers from outside competition and has steadily increased this level of protection from the time of its formation. It does accord preferential treatment to various regions. The Non-E.E.C. Western European region, on the other hand, is not attempting to achieve any high level of protection for its domestic producers. Also, this region basically treats all of its trading partners in vegetables alike. It is assigned a tariff level which is somewhat above that for the E.E.C. in 1963 for its preferentially treated regions, but below that for these same regions from 1973 on. In this way the average European level of protection, without the strong level afforded agriculture by the current CAP is built into the Non-E.E.C. Western European region's tariff level.

Final Data Set

The final data set was created by merging the assigned tariffs with the data set which contains the trade, financial, and production data. This is the data upon which the vegetable trade model is run and through which parameter estimates are obtained. It has twenty-one observations on each of the 408 endogenous and eighty-two exogenous variables, one for each year 1962 to 1982.

Summary

This chapter presented the world vegetable trade system in matrix algebra along with a discussion of several issues of importance with regards to econometric estimation of the model. These issues included methods of estimating nonlinear simultaneous systems, identification of equations in simultaneous systems in general and the identifiability of the equations of the vegetable trade system in particular, how SAS estimates nonlinear simultaneous systems, and the data which will be used to estimate the world vegetable trade system. Consideration of all these issues led to the conclusion that, from a theoretical standpoint, nonlinear 3SLS with principal components used as instrumental variables, is the best choice of methodologies. Theoretically it will yield the most efficient and least biased estimators for the world vegetable trade system.

Empirical results from estimation of the model will be presented in the next chapter. Because all functional relationships are in the double log form, all parameter estimates are elasticities. Consequently, the following chapter will present the elasticity of each region's market demand with respect to the average market price of vegetables in the region, income, and population. It will also present the regional product demand elasticities with respect to relative prices and market size, export supply elasticities with respect to the regional average export price and regional production, and finally, the CIF import price elasticities with respect to FOB export product prices and year. The signs and magnitudes of each of these elasticities will be discussed with regard to what the empirical results show versus what one would expect from economic theory. Implications of possible discrepancies will be discussed.

Finally, given the estimated parameters, simulations will be carried out where one variable of the system, say a tariff level of the E.E.C., is changed and the impact on vegetable trade is measured. Simulations will be carried out with major changes in market prices, incomes, populations, production levels, and average regional export prices. These are among the strongest forces driving international trade in vegetables. For a complete study of this trade, it is important to have some measure of the

impacts of changes in the levels of these variables. The development of a simultaneous system for world vegetable trade, its estimation, discussion of the empirical results and use of these results to simulate the effects of changes in major factors driving international trade will comprise the extent of this study and together, will form a complete analysis of world vegetable trade.

CHAPTER VI

RESULTS OF ECONOMETRIC ESTIMATION

Introduction

Initial estimation of the world trade model was carried out using nonlinear 3SLS, an instrumental variables technique. The model includes several independent variables, hence principal components were used as instruments in the first stage of estimation. To construct these instruments, twenty-five explanatory variables were used to compute twenty-five principal components; five of the principal components accounted for ninetyeight percent of the variation in the explanatory variables. Thus these five were used in the estimation of the parameters for the trade system (see Appendix F).

Three stage least squares was used to allow for the possibility of some external event or force acting upon the world's vegetable trade which affected all markets. If this were the case, there would be some degree of correlation among the errors across the equations and the use of 3SLS would take it into account, thus improving the efficiency of the parameter estimates. Analysis of the correlation matrix of the parameters, however, revealed that there was very

little correlation in the errors across equations and regions. Thus little to no advantage was gained with the use and added expense of 3SLS. Consequently the final estimation of the model was completed using 2SLS. The correlation matrix is over 100 pages of computer print-out and therefore will not be presented in the dissertation.

The system estimated with nonlinear 2SLS calculated parameters for four types of functional relationships for each trade region. These relationships were market demands, product demands, export supplies, and CIF import prices. The system of equations was restricted by identities for the average market prices, the market prices for products, the average export prices, demand restrictions, and supply restrictions. The entire simultaneous system was presented in Chapter IV. The equations for which parameters were estimated include, using Chapter IV's notation, equations (4.18), (4.19), (4.20), and (4.21), or:

Market Demands

$$(6.1)\ \log X(i.) = \log \delta(0i) + \delta(1i) \log P(i.) + \delta(2i) \log GDP(i) + \delta(3i) \log Pop(i)$$

Product Demands

$$(6.2)\ \log X(ij) = \log \phi(0ij) + \phi(1ij) \log P(ij) - \phi(1ij) \log P(i.) + \phi(2ij) \log X(i.)$$

Export Supplies

$$(6.3)\ \log [\ X(ij) - X(jj)\ ] = \log \rho(ij) + \rho(1j) \log F(.j) + \rho(2j) \log Prd(j)$$

CIF Import Prices

$$(6.4)\ \log C(ij) = \log \Phi(0ij) + \Phi(1ij) \log F(ij) + \Phi(2ij) \log Year$$

Note that because each of these equations is in double log form, the estimated parameters are actually elasticities, or reflect percentage adjustments to percentage changes.

The remainder of this chapter will discuss the results of the nonlinear 2SLS estimation. Graphs of the more important relationships and trade patterns will be presented. Statistics indicating the performance of the model will be presented. Each type of relationship will be addressed separately, focusing on the signs and values of the parameter estimates for each region. The signs will be examined as to what one would expect given economic theory and what the actual results were. Possible explanations for any discrepancies will be suggested. The magnitudes of the estimated parameters or elasticities will be discussed. These will indicate the responsiveness of the dependent variables to the explanatory variables. When possible, estimation results will be considered in relation to the trade system as described in Chapter II, which details the

characteristics of trade and production of fresh vegetables in a descriptive manner. However, the purpose of this chapter is to present the empirical results of the model's estimation.

Chapter VII will discuss the linkage between the empirical evidence and the patterns of trade observed for fresh vegetables. In that chapter all regions will be reviewed from the demand and supply side, but particular attention will be given to the U.S.' demand elasticities on both the market and product level, and to other regions' demand elasticities for U.S. vegetables. Added focus will also be given to regional product demand parameters for E.E.C. and Far Eastern vegetables. These three regions dominated world trade in vegetables from 1962 to 1982. The estimation results of the world trade system will yield insights as to how these three relate to each other and to the other regions of the world.

Graphs of Selected Relationships

Graphs of predicted and actual data points for total exports from all eight regions, market demands for all eight regions, and the product demands which compose the majority of vegetable trade as identified in Chapter II are presented in Figures 6.1 through 6.44. These are presented as quantities over time, with quantities measured in thousands or millions of metric tons, depending upon which is more

appropriate for each particular relationship. Note that the scales of measurement, as well as the units, are allowed to change from figure to figure. Consequently one figure may measure a product demand in thousands of metric tons with a scale that changes by twenty thousand on the vertical axis. Another product demand may be measured in millions of metric tons with a scale that changes by two on the vertical axis. Because of the variation allowed in the units and scales of measurement, it is not possible to casually glance at the discrepancies between the actual and predicted plots and deduce that the model does a better job of predicting one relationship than another. In order to do that, it would be necessary to account for the units of measurement. A more efficient, and more scientific, way of discerning the relative fit of the model's relationships is to examine the R square values as well as the error sums of squares, percentage root mean square errors, and Theil inequality coefficients. This will be done later in the chapter.

What can be deduced from the figures is the general direction of each relationship, increasing or decreasing over time, and whether the model captures the general trends and the turning points in the data. Also, major discrepancies between actual and predicted values can be seen quite readily. In every case, the model predictions follow the same general trend of the actual data. For example, if exports have increased over time from a region,

the model's predictions of those exports also increased, and vice versa. This speaks very well of the model; the model does capture the real world trends occurring in fresh vegetable trade. The predicted values also usually capture the turning points in the actual data. In a few of the relationships, there are one or two major discrepancies between actual quantities and those predicted by the model. These outliers are usually isolated, only in one or two of a few years, and generally occurred in the relationship of a third world nation where a weaker infrastructure for data collection exists. These outliers are indicative of a few isolated data problems rather than model construction.

Figures 6.1 through 6.8 provide the predicted market demands for the eight regions. Except for periods in the Middle East, the model's predictions are acceptable where general trends and major turning points are captured. Note in particular the values for the U.S. This is one of the most accurate graphs, with the predicted values very close to the actual data. Overall the model's ability to predict aggregate demands is one of its stronger points.

Total fresh vegetable exports are shown in Figures 6.9 to 6.16. Again the graphs capture the general directions and major turning points of the relationships. While it appears, from casual inspection, that the market demands' predicted values have less discrepancy from the actual values than do those for the export supply equations, it

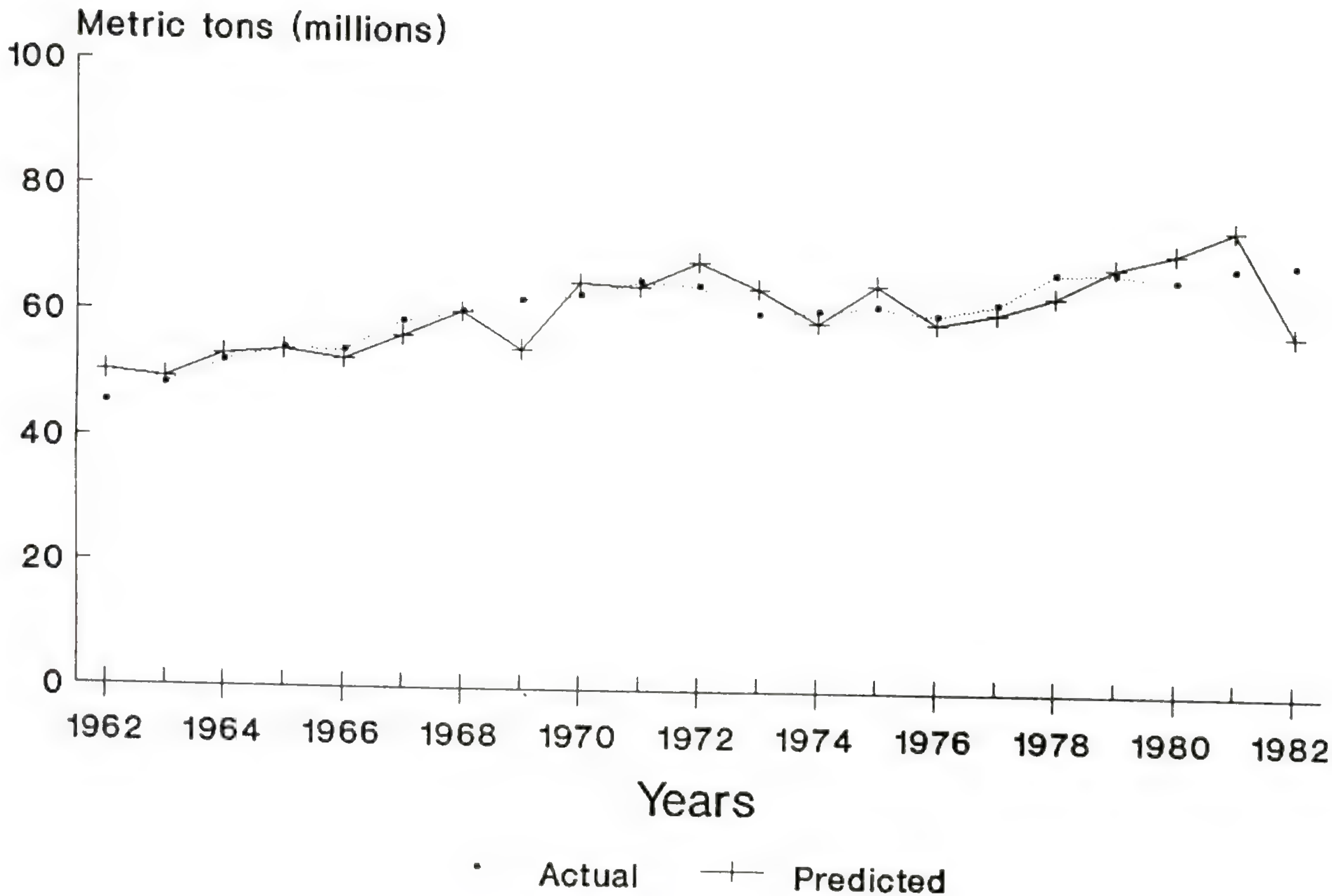

FIGURE 6.1

THE MARKET DEMAND FOR FRESH VEGETABLES IN LATIN AMERICA.

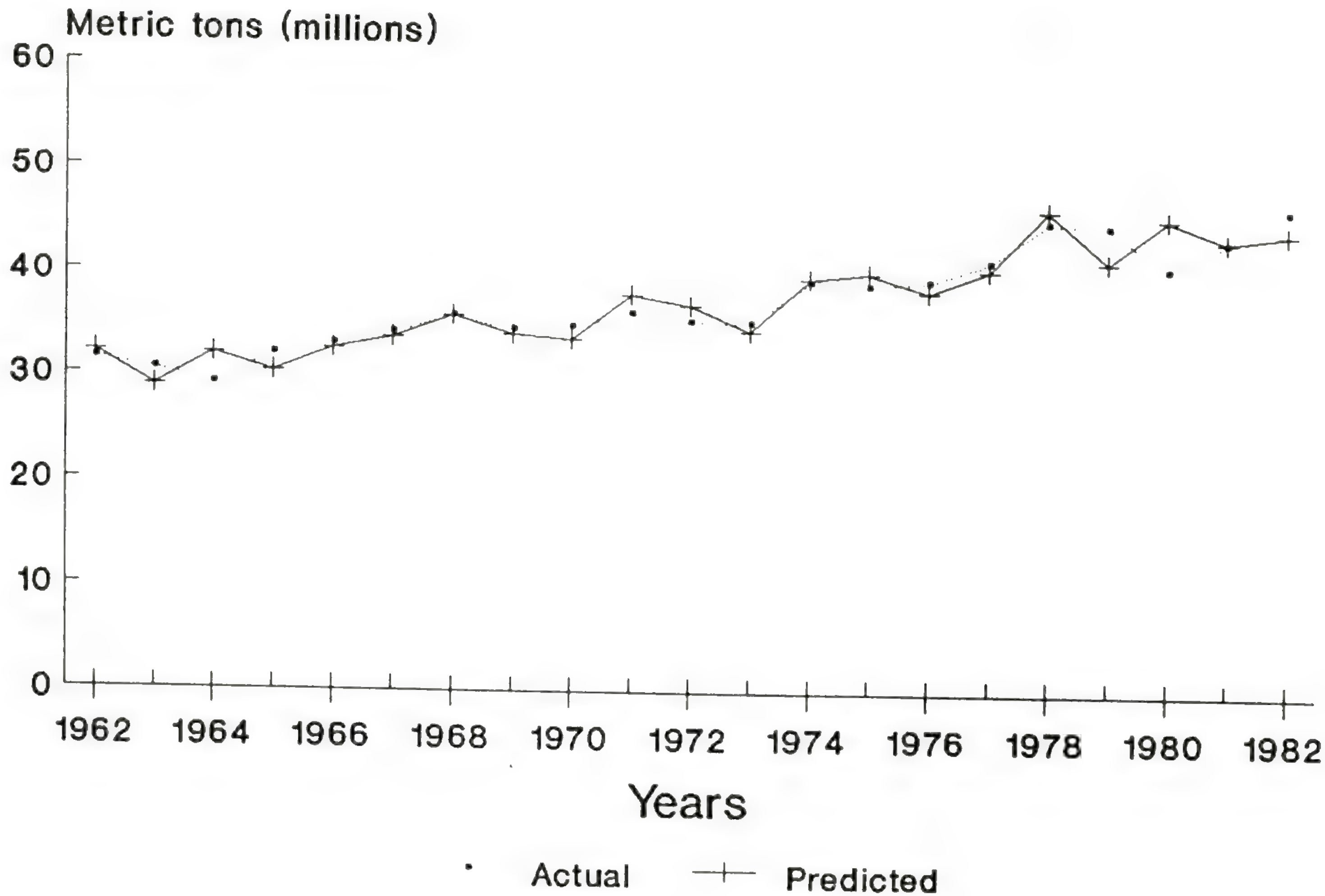

FIGURE 6.2

THE MARKET DEMAND FOR FRESH VEGETABLES IN THE U.S.

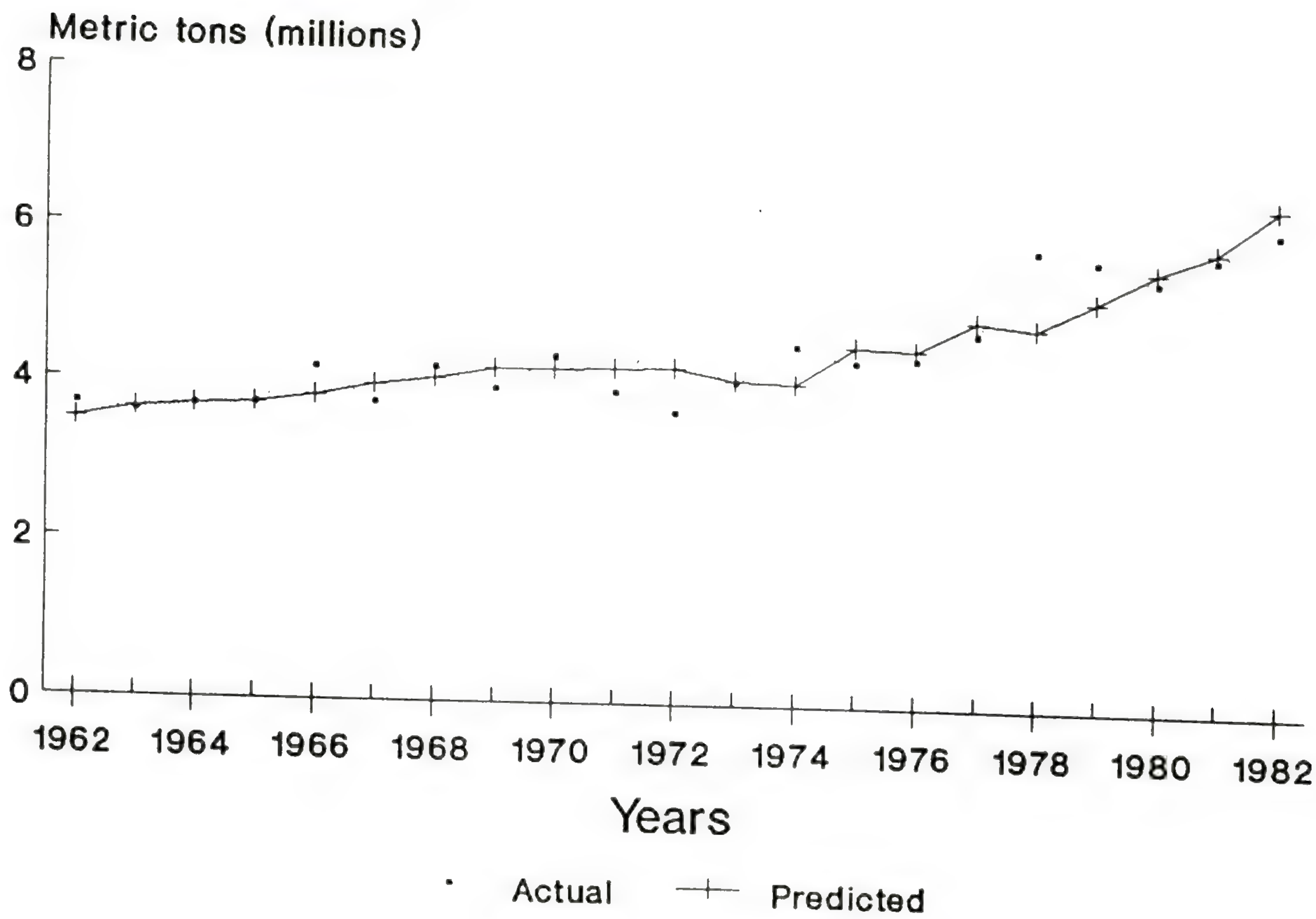

FIGURE 6.3

THE MARKET DEMAND FOR FRESH VEGETABLES IN CANADA.

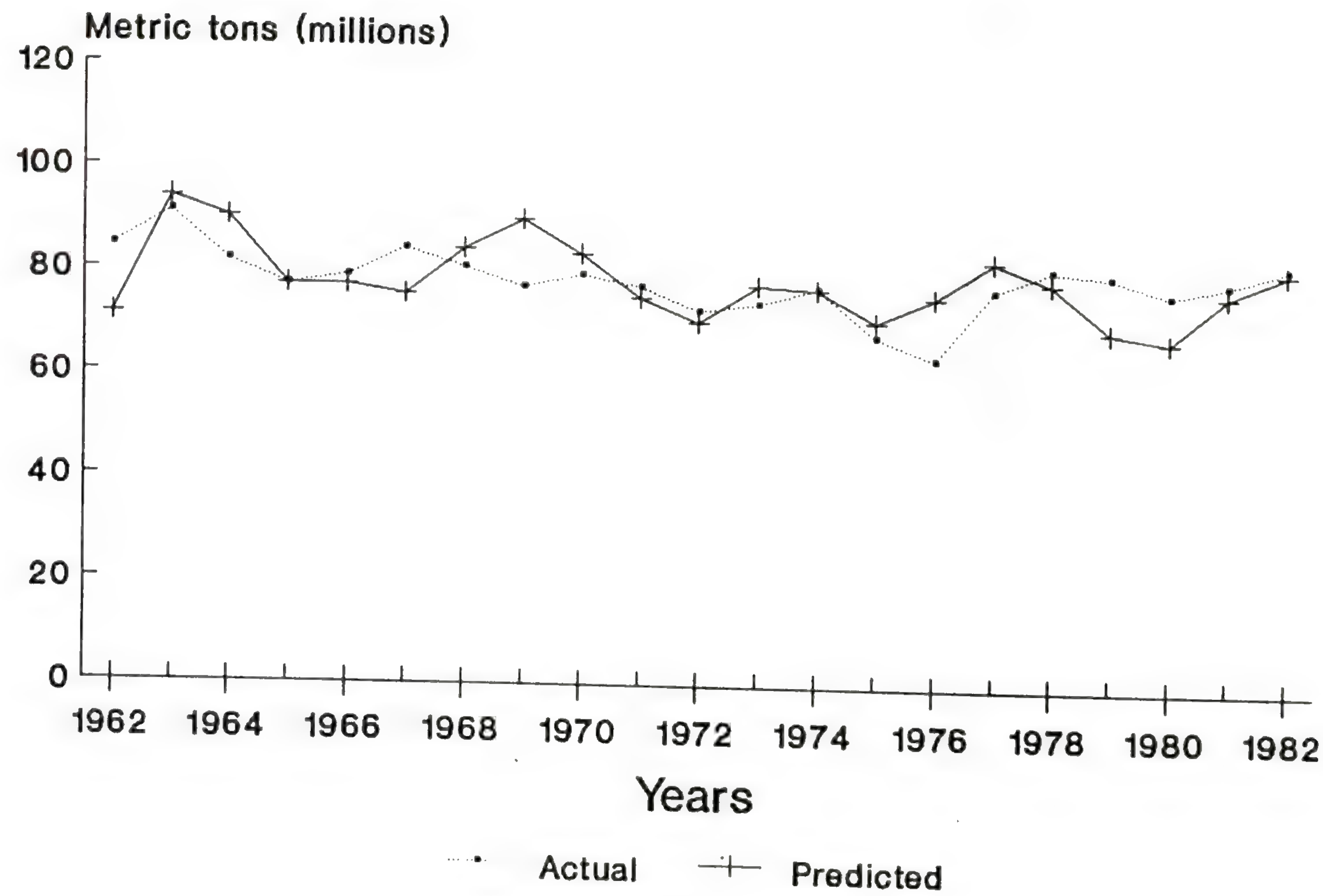

FIGURE 6.4

THE MARKET DEMAND FOR FRESH VEGETABLES IN THE E.E.C.

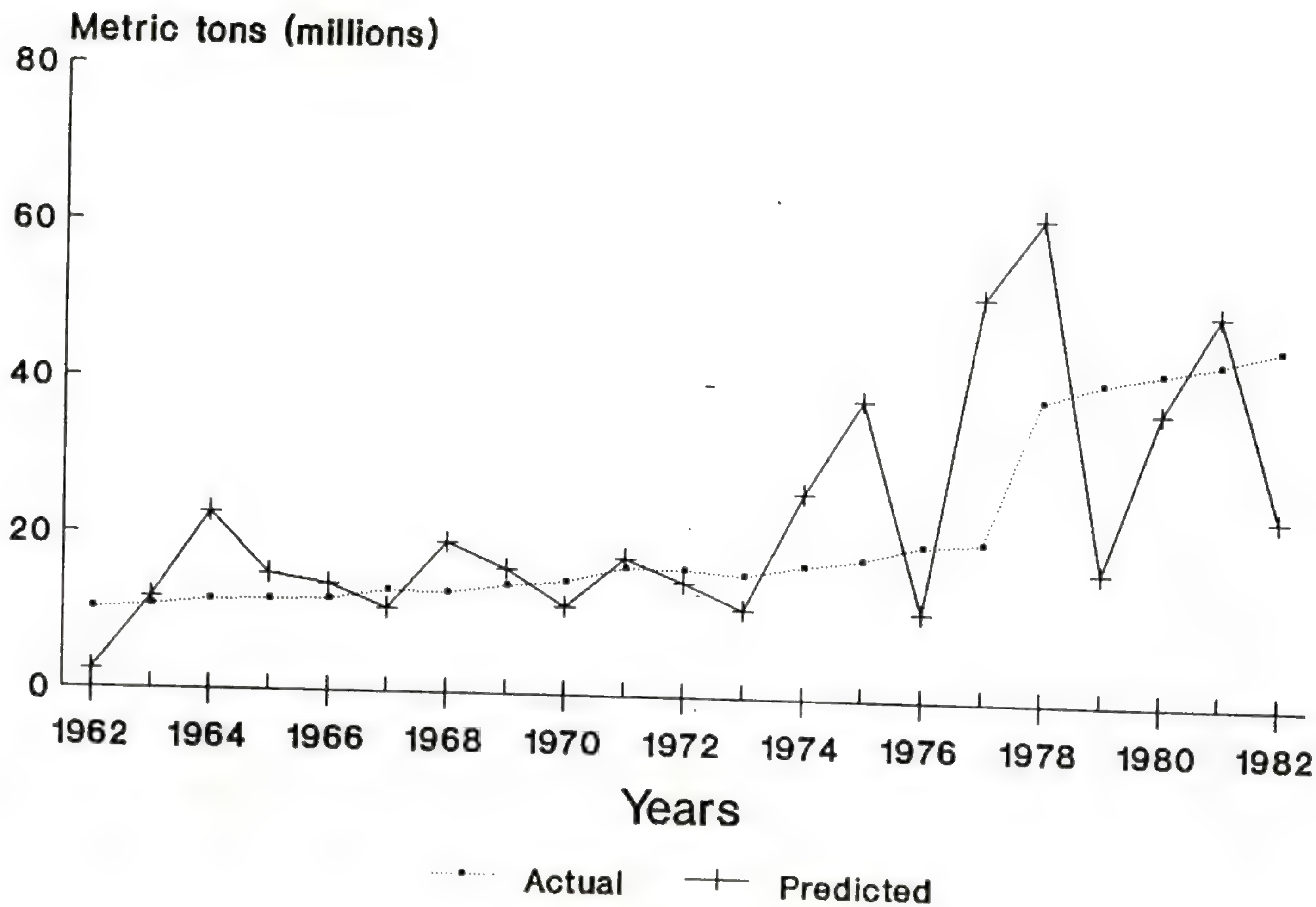

FIGURE 6.5

THE MARKET DEMAND FOR FRESH VEGETABLES IN THE MIDDLE EAST.

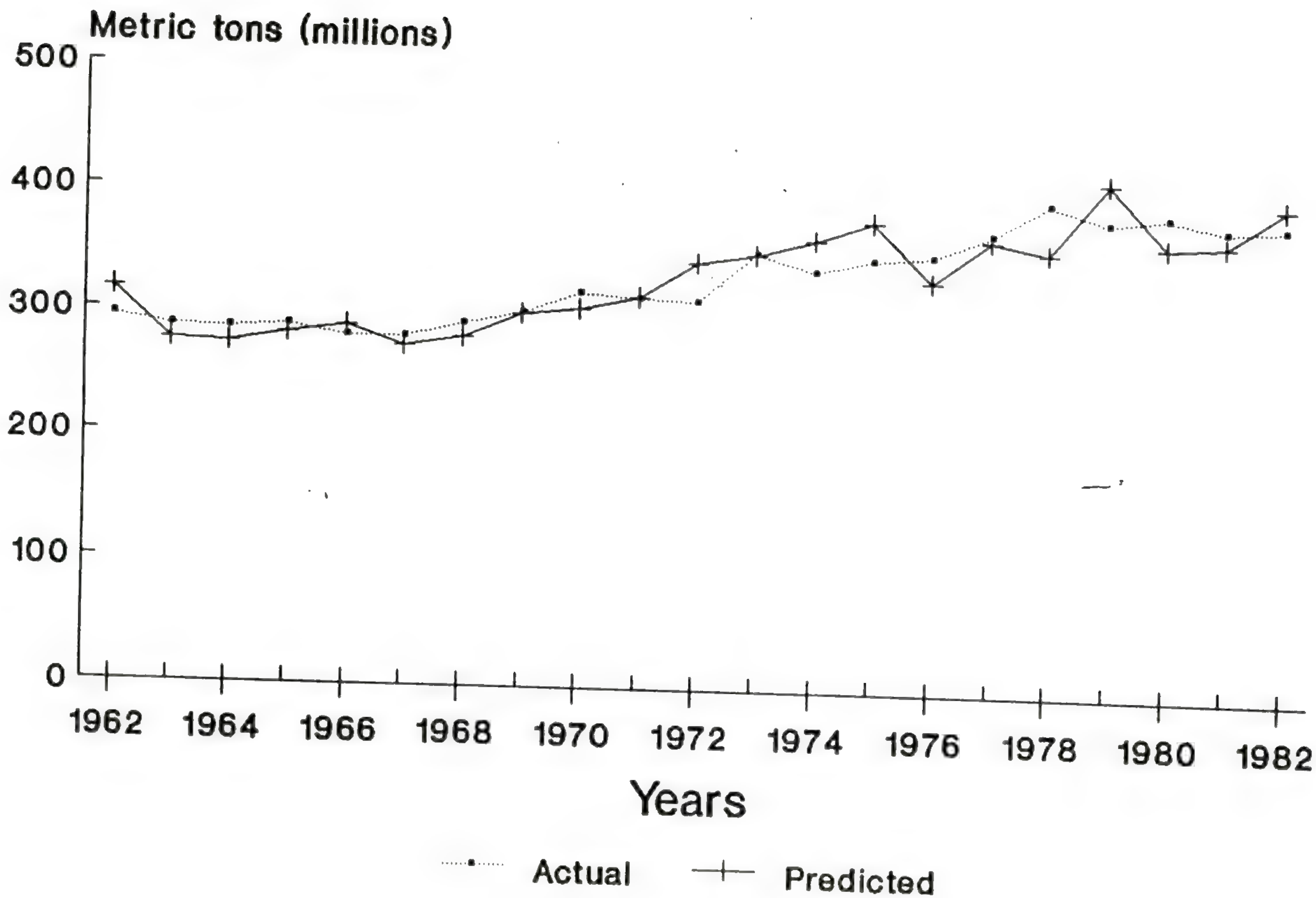

FIGURE 6.6

THE MARKET DEMAND FOR FRESH VEGETABLES IN THE FAR EAST.

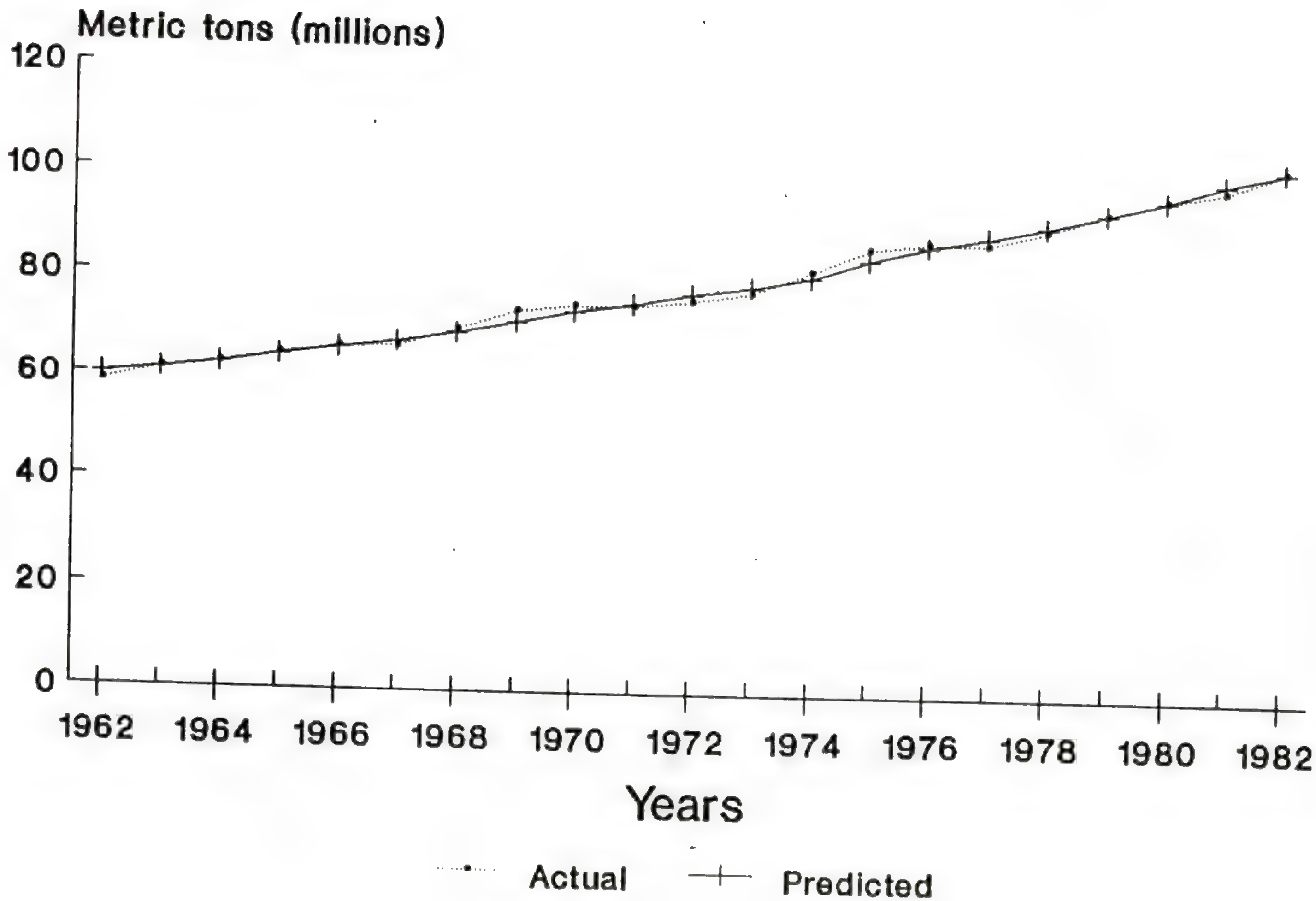

FIGURE 6.7

THE MARKET DEMAND FOR FRESH VEGETABLES IN AFRICA.

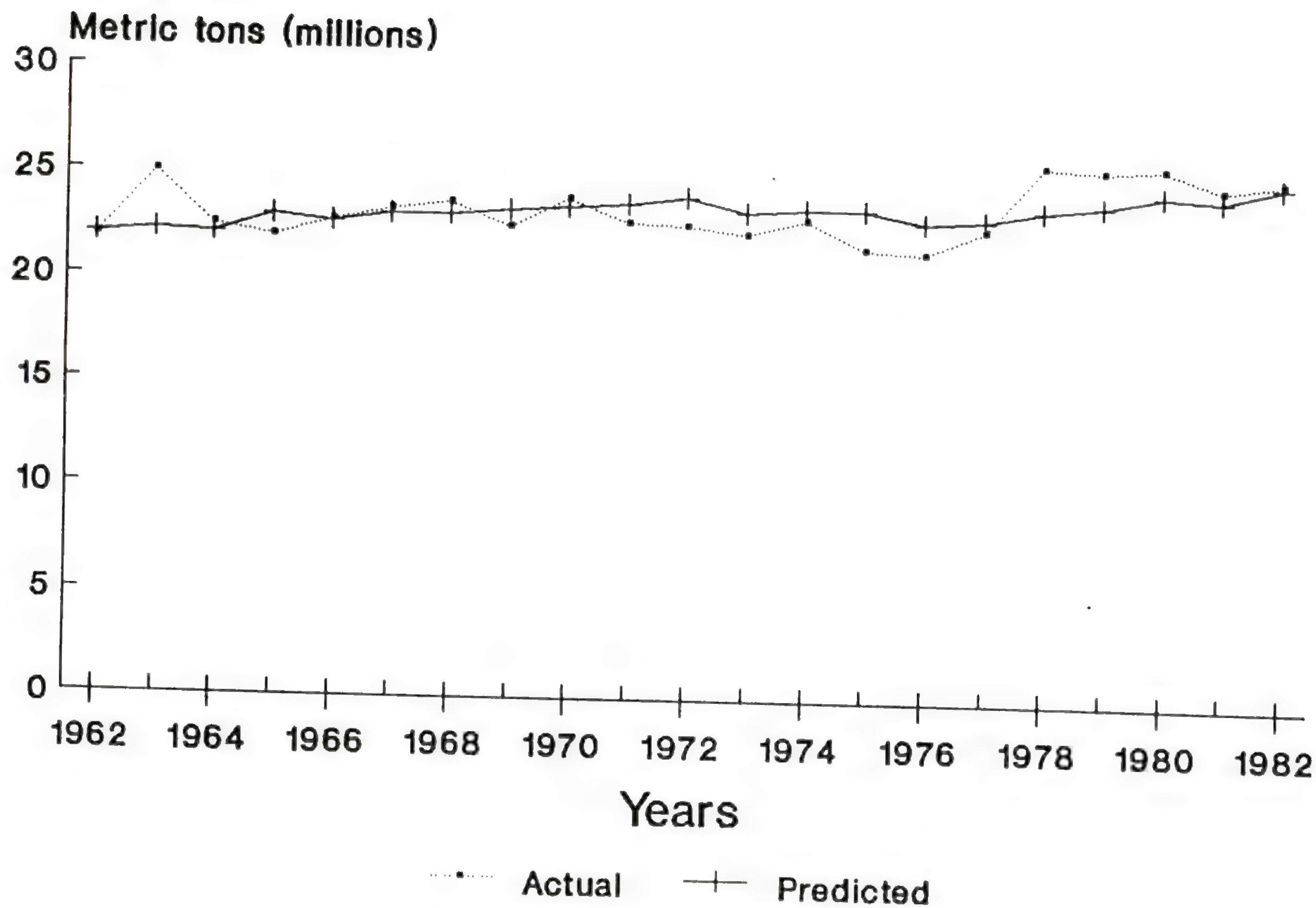

FIGURE 6.8

THE MARKET DEMAND FOR FRESH VEGETABLES IN NON-E.E.C. W. EUROPE.

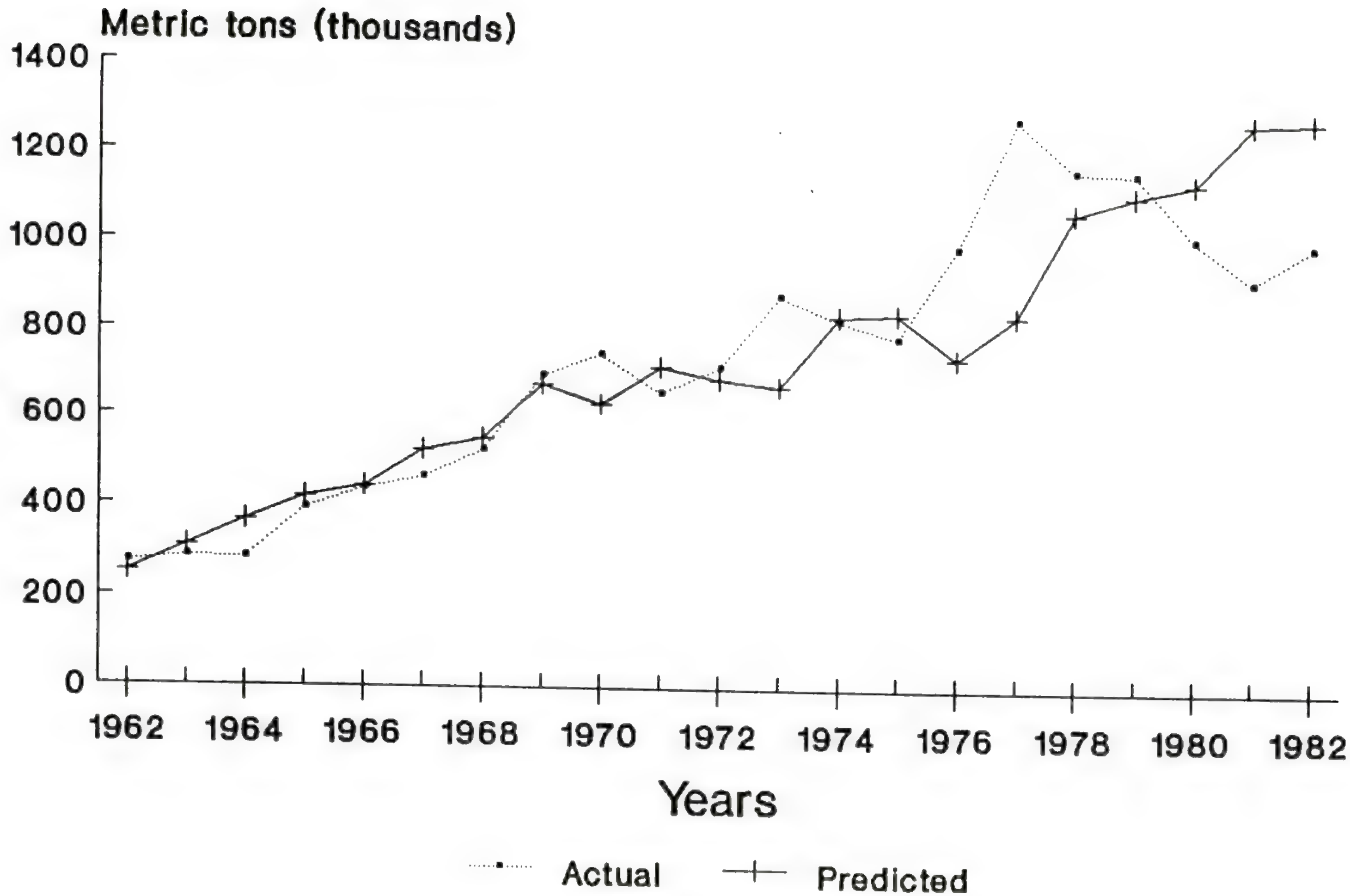

FIGURE 6.9

TOTAL EXPORTS OF FRESH VEGETABLES FROM LATIN AMERICA.

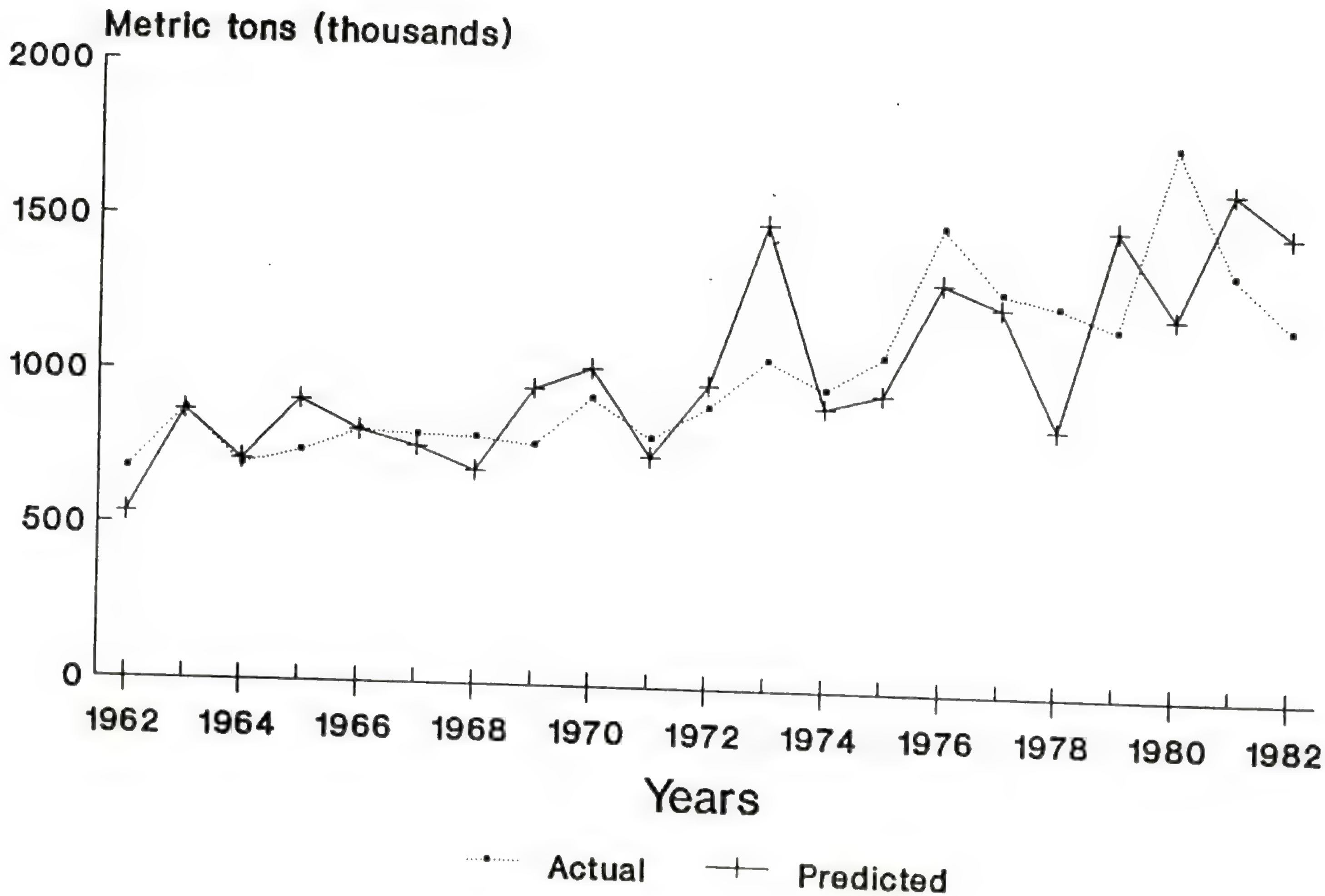

FIGURE 6.10

TOTAL EXPORTS OF FRESH VEGETABLES FROM THE U.S.

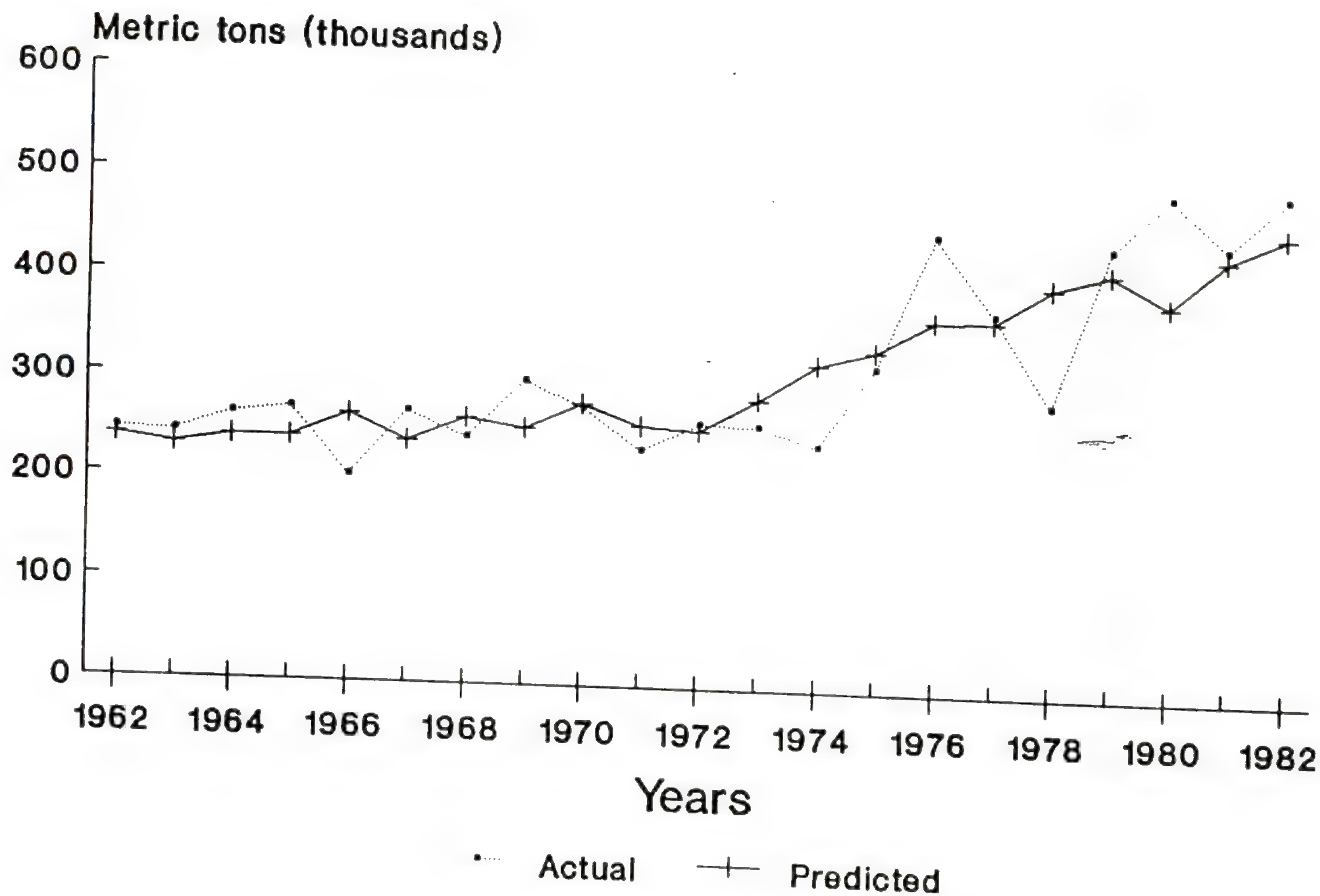

FIGURE 6.11

TOTAL EXPORTS OF FRESH VEGETABLES FROM CANADA.

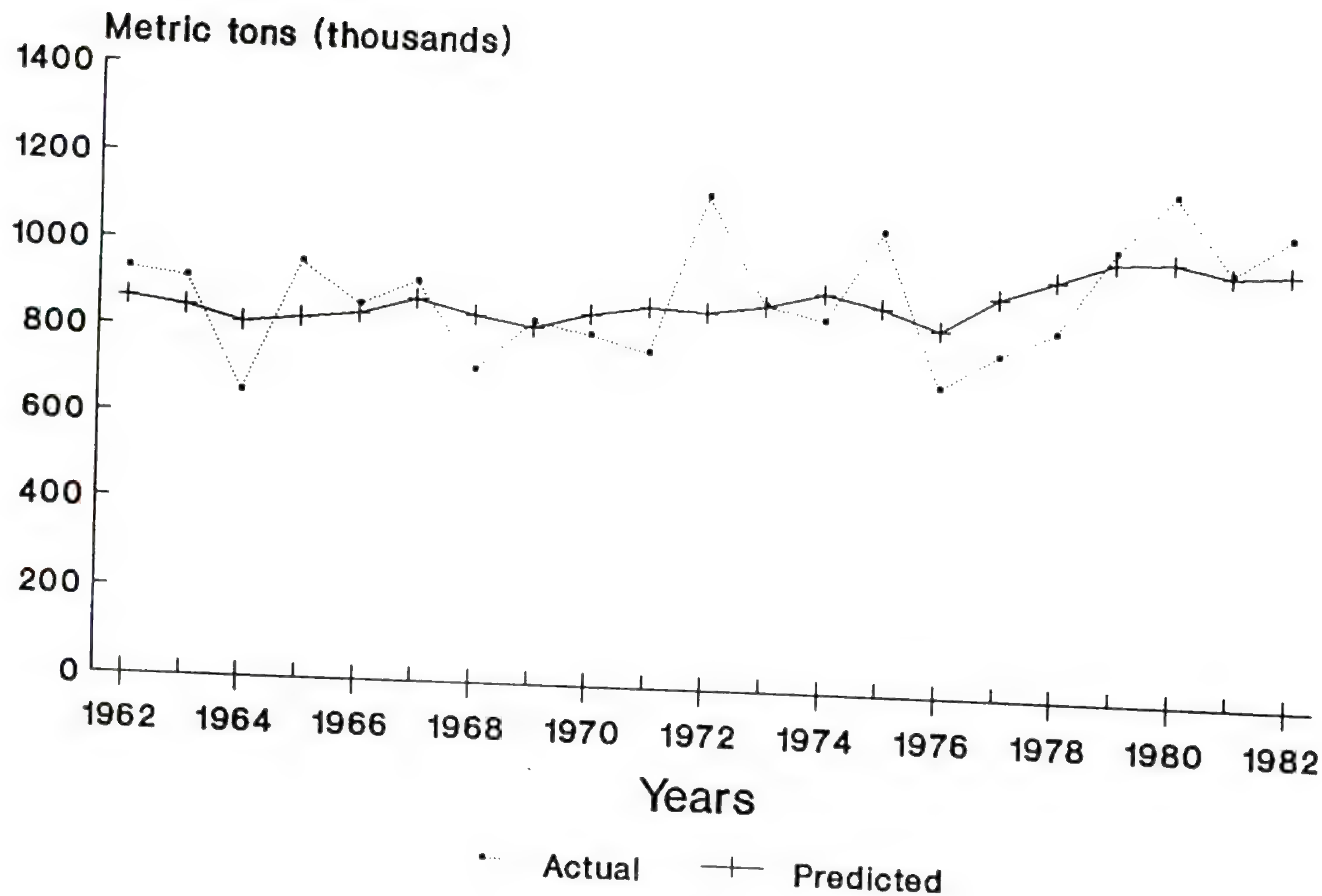

FIGURE 6.12

TOTAL EXPORTS OF FRESH VEGETABLES FROM THE E.E.C.

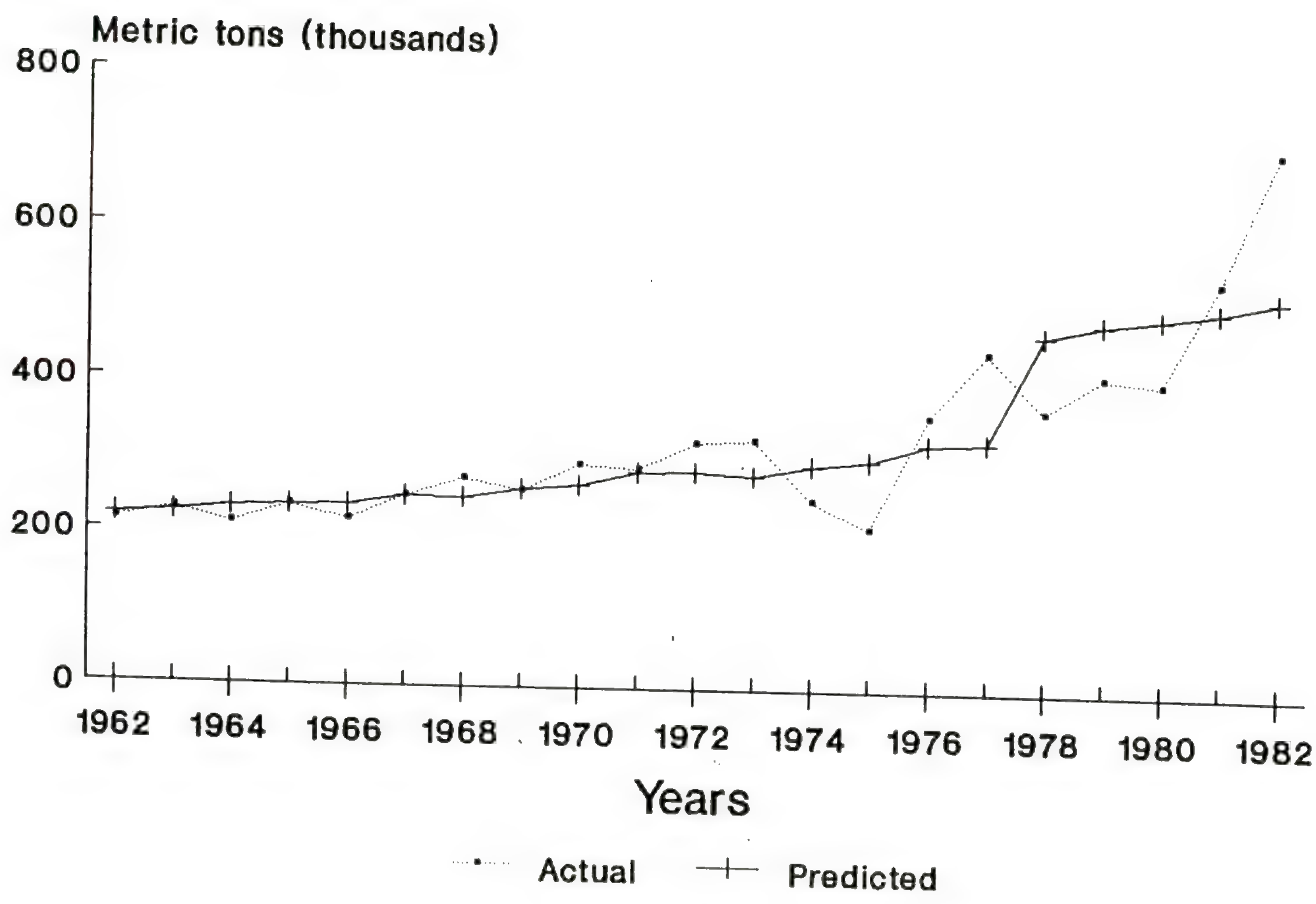

FIGURE 6.13

TOTAL EXPORTS OF FRESH VEGETABLES FROM THE MIDDLE EAST.

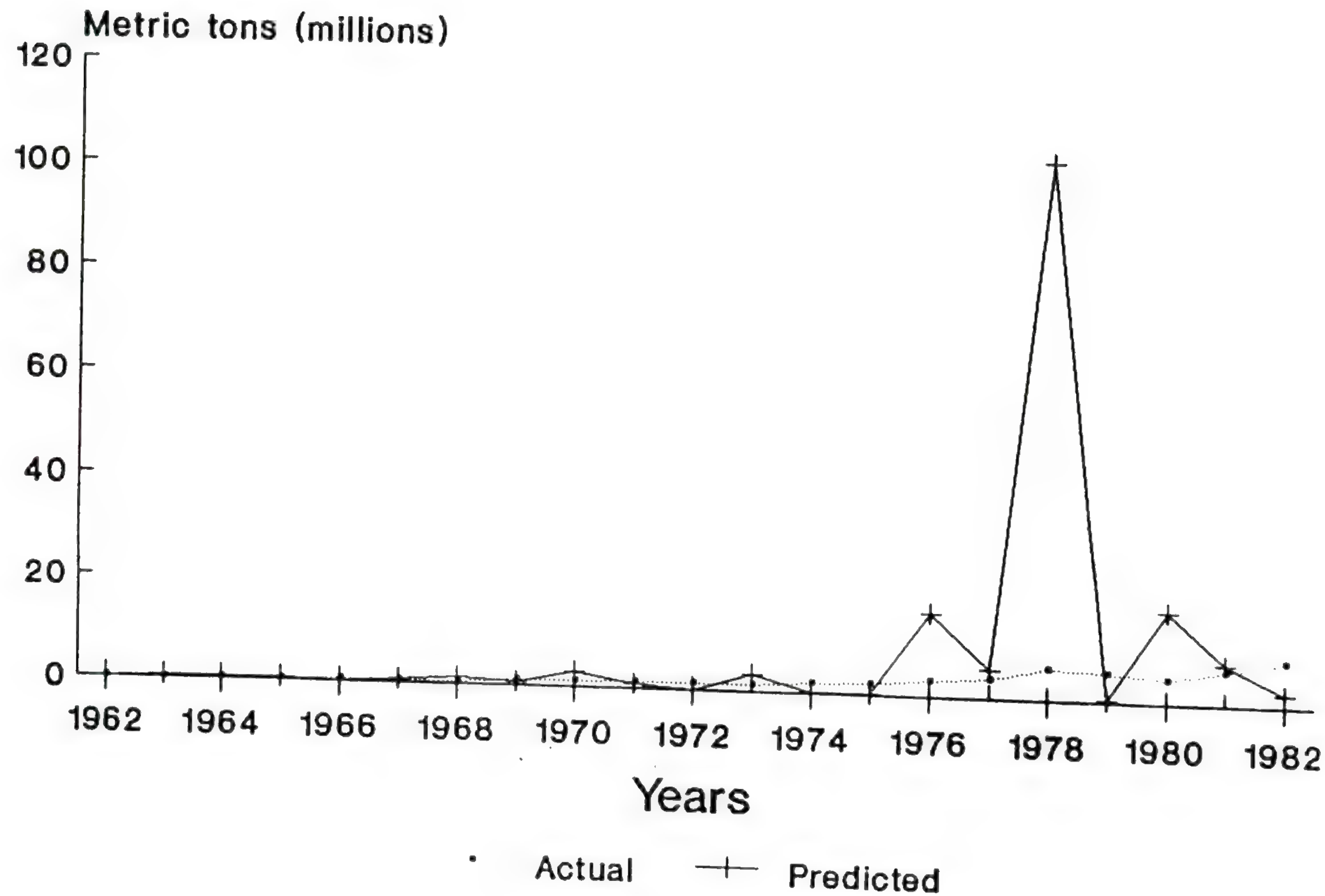

FIGURE 6.14

TOTAL EXPORTS OF FRESH VEGETABLES FROM THE FAR EAST.

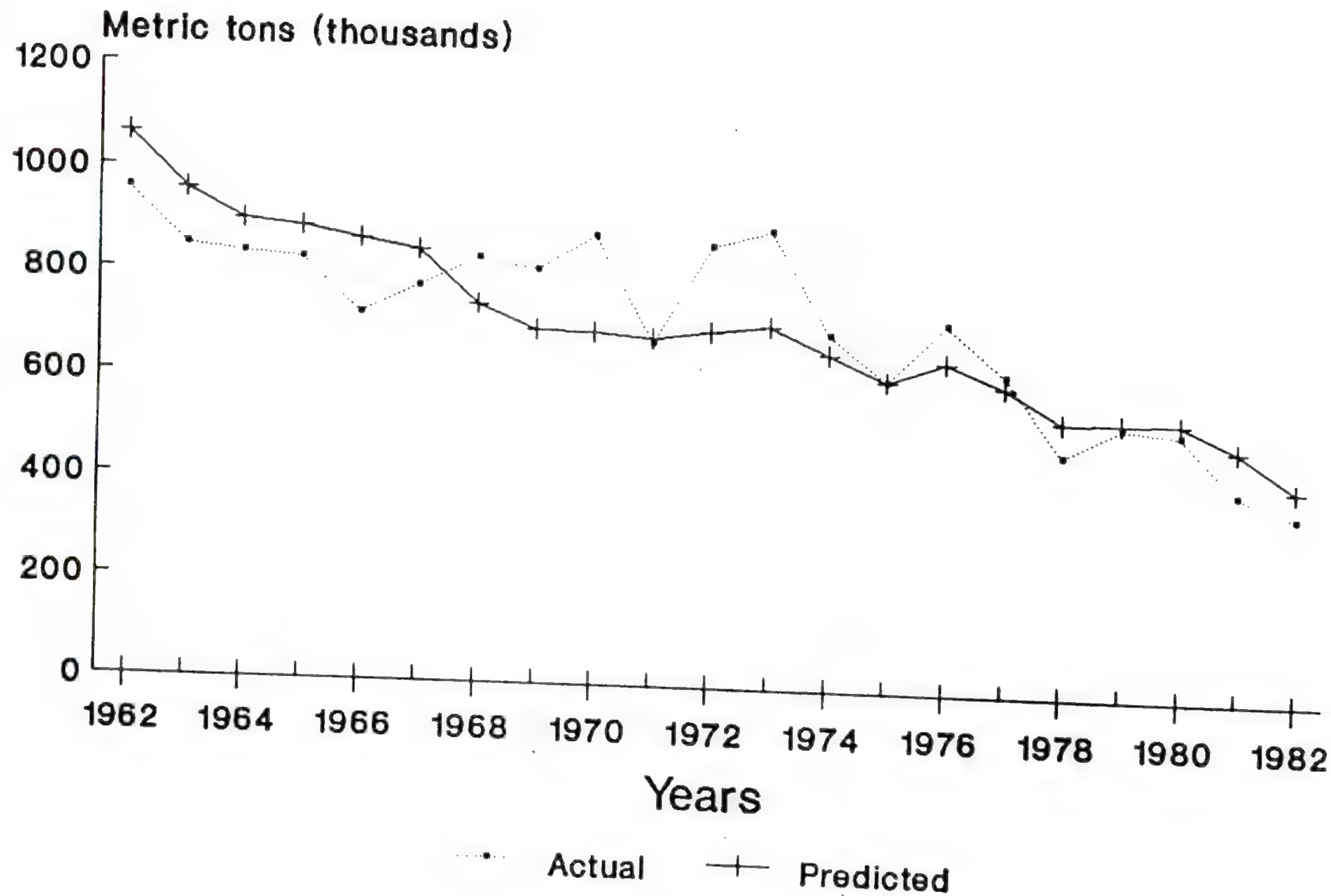

FIGURE 6.15

TOTAL EXPORTS OF FRESH VEGETABLES FROM AFRICA.

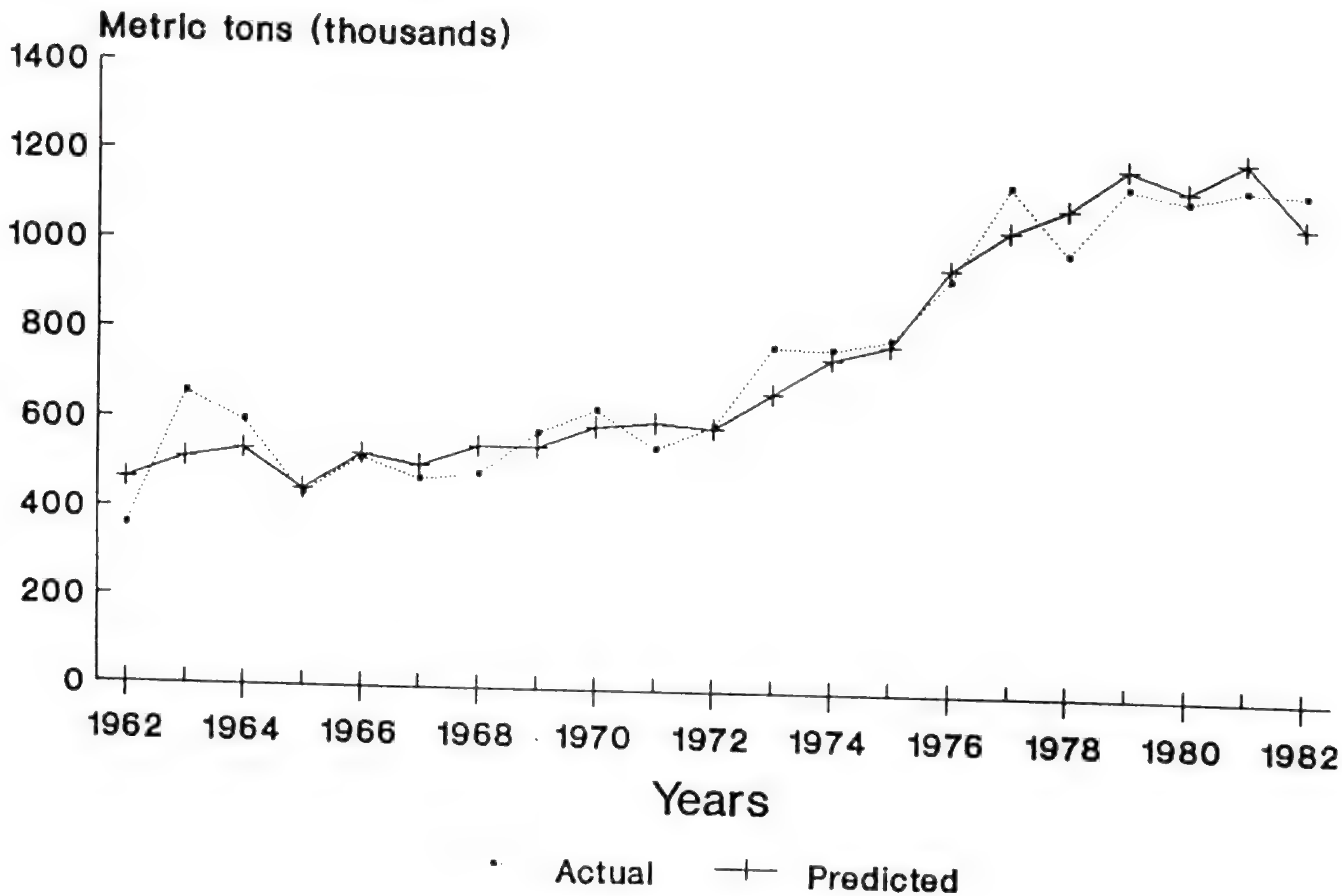

FIGURE 6.16

TOTAL EXPORTS OF FRESH VEGETABLES FROM NON-E.E.C. W. EUROPE.

must be noted that the scales of the figures of the two types of relationships differ. The figures for market demands are all done in millions of metric tons and export supplies, with the exception of the Far East, are in thousands of metric tons. Thus while discrepancies between predicted and actual values in the export supply graphs look larger than do those in the market demand graphs, this is not necessarily the case. Note that the tremendous growth in Far Eastern exports is captured by the model, with the predicted values closely mirroring the actual values. There is one extreme outlier in the model's prediction of Far Eastern exports. Africa's dramatic decline in exports is also captured by the model, with predicted values very close to actual values. All of the export supply relationships are predicted quite accurately by the model.

The remaining figures, 6.17 through 6.44, illustrate regional demands for vegetables from a specific region, or product demands. Only those product demands identified as key to understanding international fresh vegetable trade are included. Twenty-eight such demands are illustrated. All of these figures are measured in thousands of metric tons, with the exception of the E.E.C.'s demand for Far Eastern vegetables which is in millions of metric tons (see Figure 6.27). This figure clearly illustrates the model's ability to capture the major trends in product demands. The growth and major turning points in E.E.C. demand for Far Eastern

vegetables, one of the dominant patterns of fresh vegetable trade from 1962 to 1982, is captured by the model.

The figures are presented according to the number of the demanding and supplying regions. For example, Latin America is number one in the model and its demands for Canadian, number three, and E.E.C., number four, vegetables are illustrated in Figures 6.17 and 6.18. While the model's yearly predictions of Latin American demands for Canadian vegetables are not terribly accurate, the model does capture the general trend upward and the major turning points. The predictions for Latin America's demand for E.E.C. vegetables also capture the trends and are quite accurate from year to year.

The U.S.' demand for Latin American vegetables is illustrated in Figure 6.19 and it too captures the general trends as well as being quite accurate from year to year. The predictions of the U.S.'s demand for E.E.C. vegetables, Figure 6.20, capture the trends but do not run the gamut of the actual values. The actual values oscillate quite a bit around the predicted values.

Canadian demands for Latin American, U.S., and Non-E.E.C. Western European vegetables are predicted in Figures 6.21 through 6.23. Those for Latin American and U.S. vegetables, which make up the majority of Canadian imports, are quite accurate. Those for the Non-E.E.C. Western European region, while capturing the general trends, are not terribly accurate from year to year.

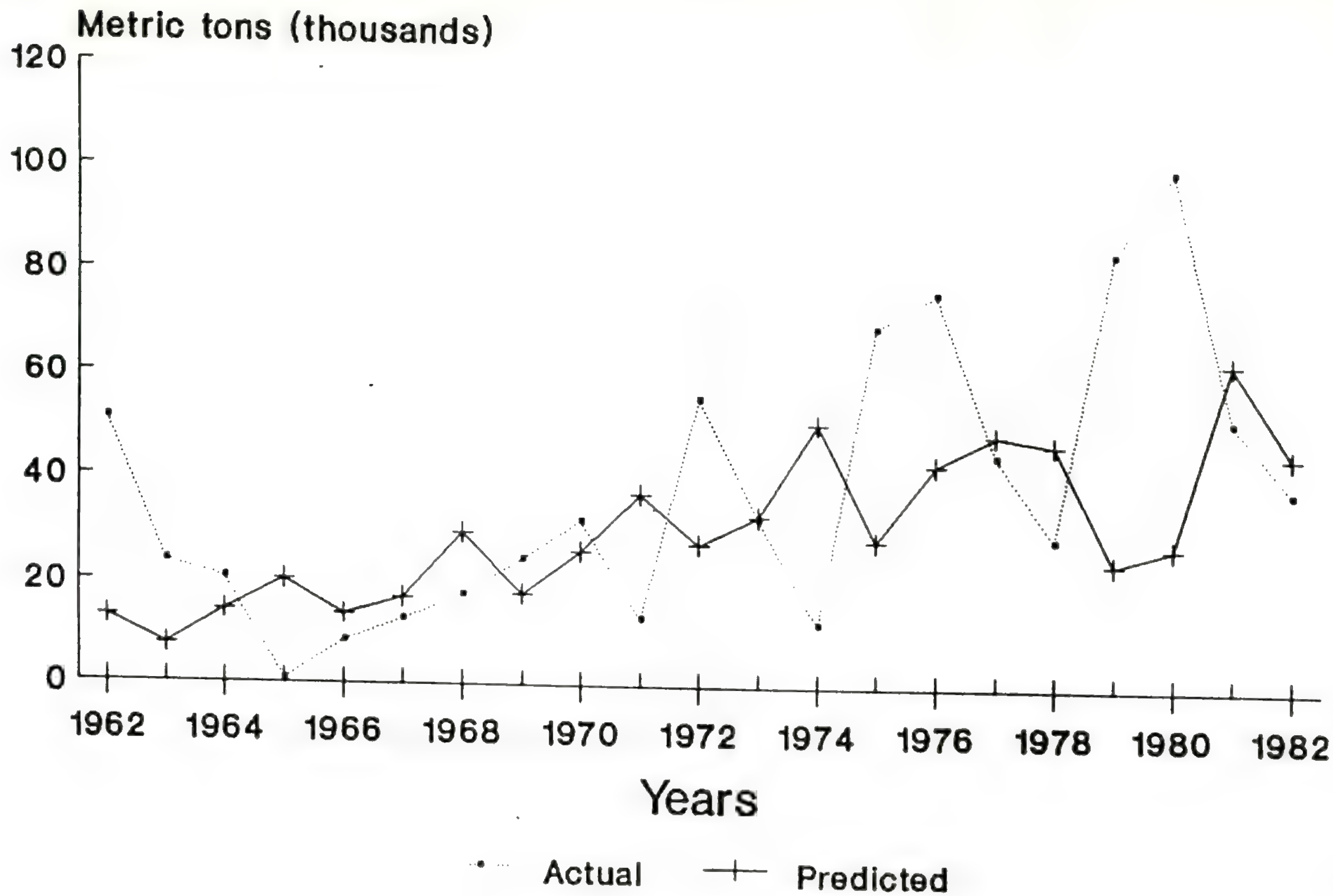

FIGURE 6.17

LATIN AMERICAN DEMAND FOR CANADIAN FRESH VEGETABLES.

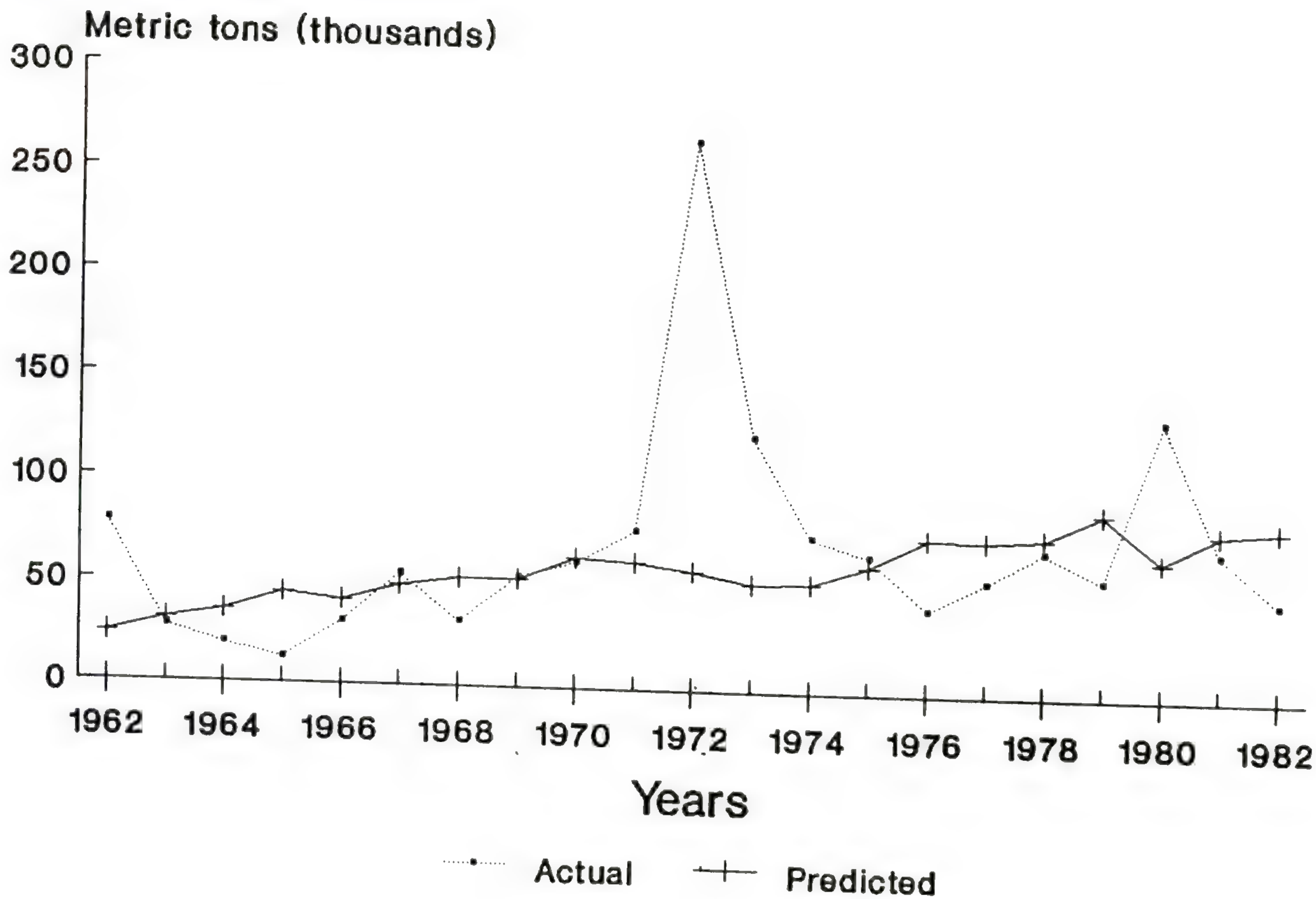

FIGURE 6.18

LATIN AMERICAN DEMAND FOR E.E.C. FRESH VEGETABLES.

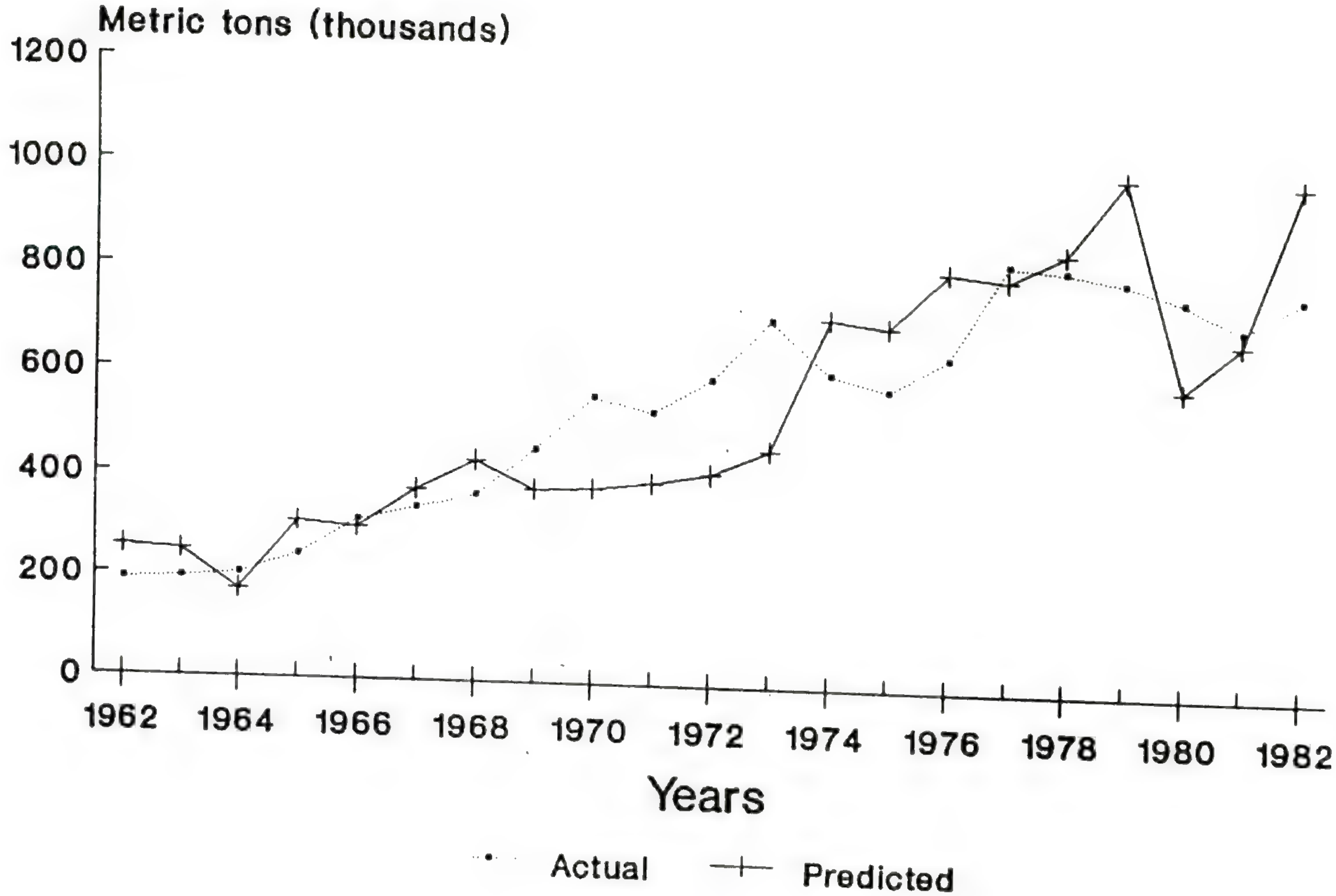

FIGURE 6.19

U.S. DEMAND FOR LATIN AMERICAN FRESH VEGETABLES.

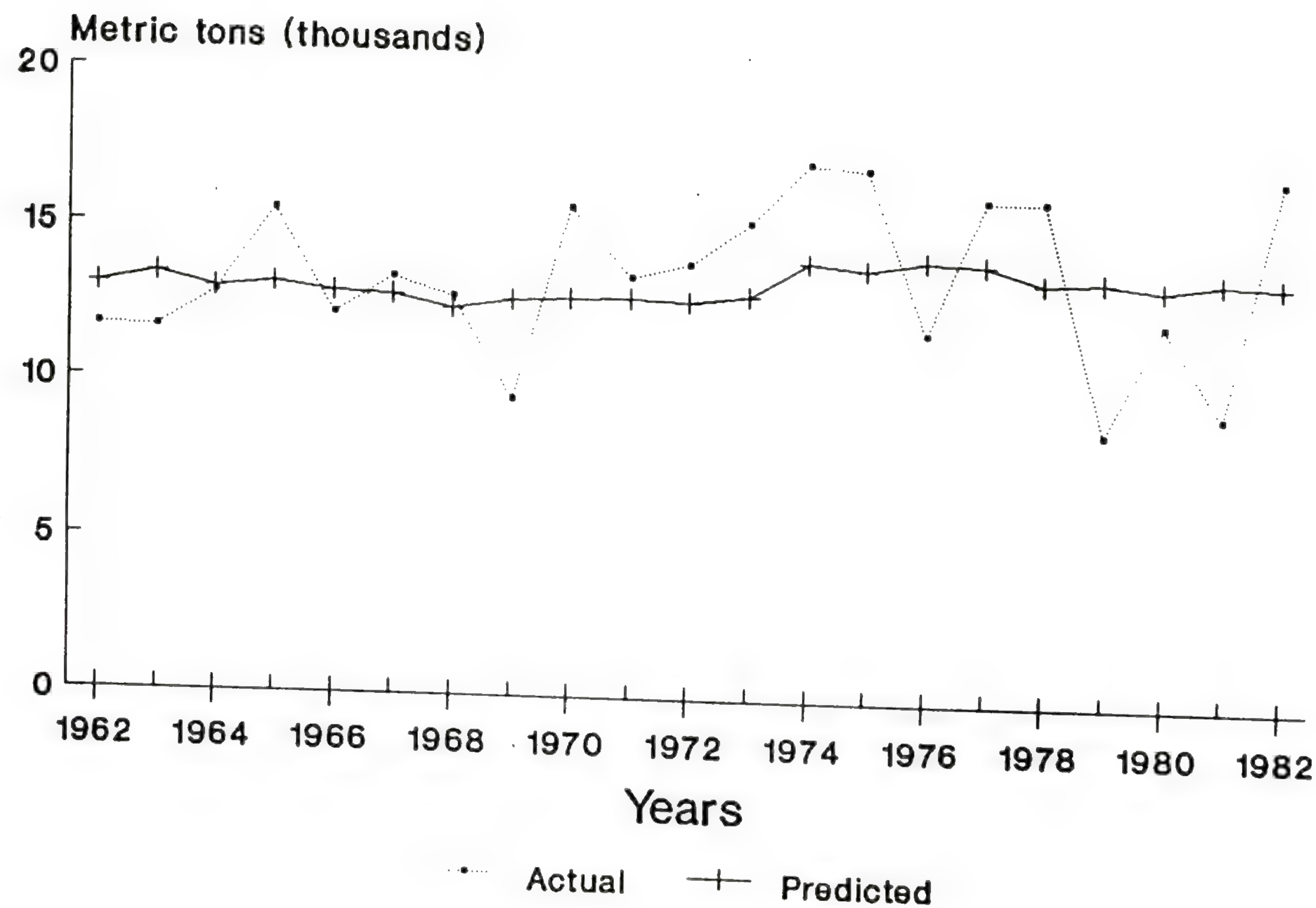

FIGURE 6.20

U.S. DEMAND FOR E.E.C. FRESH VEGETABLES.

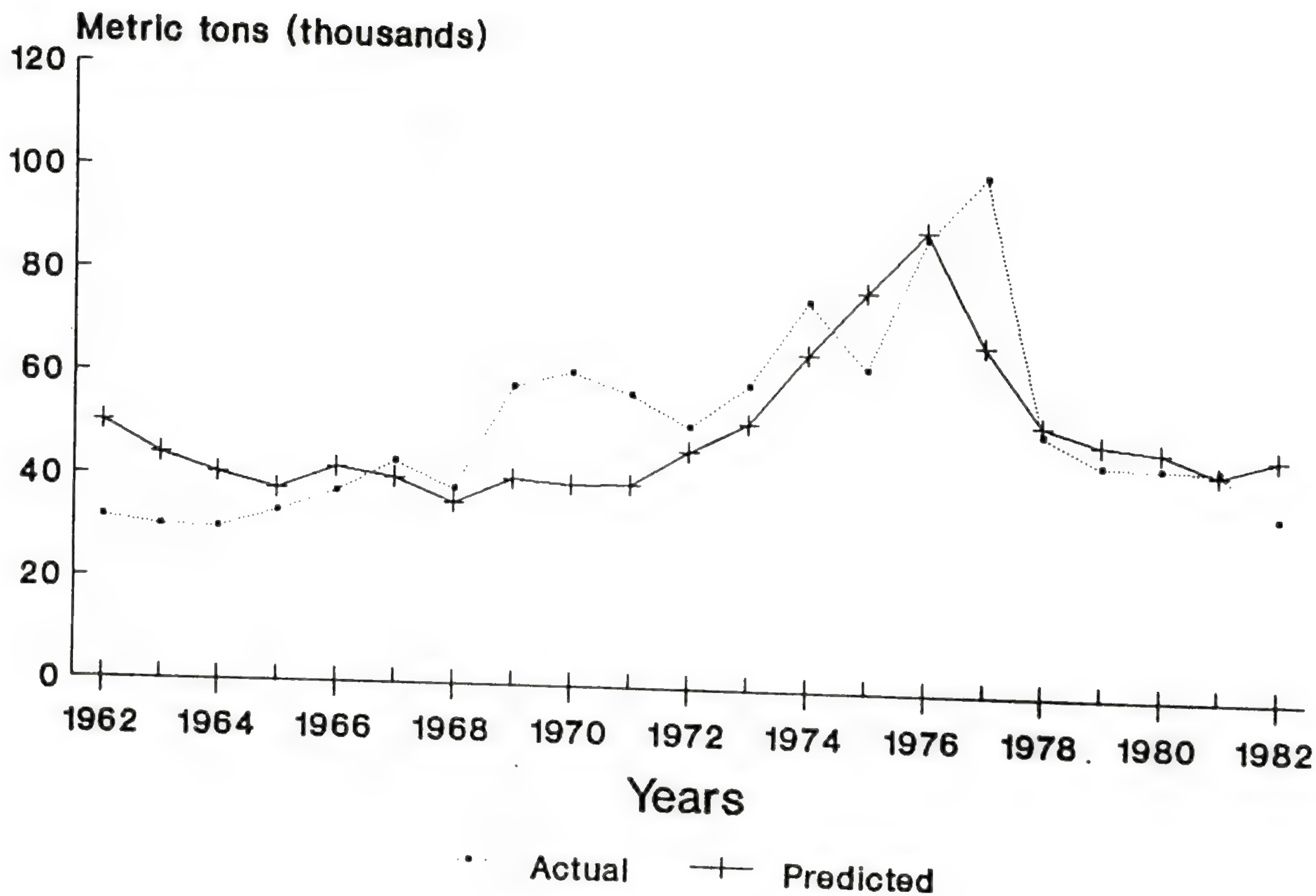

FIGURE 6.21

CANADIAN DEMAND FOR LATIN AMERICAN FRESH VEGETABLES.

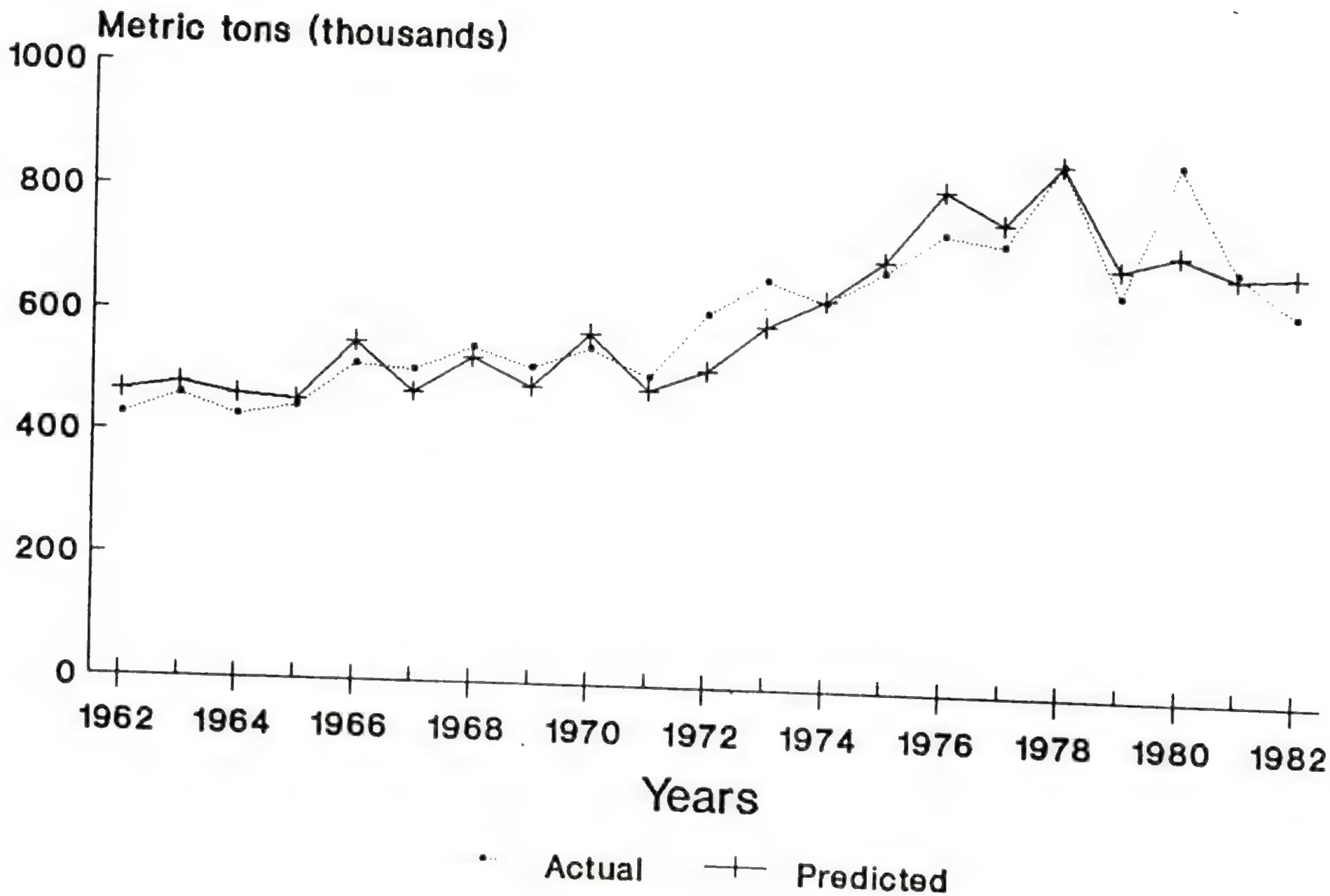

FIGURE 6.22

CANADIAN DEMAND FOR U.S. FRESH VEGETABLES.

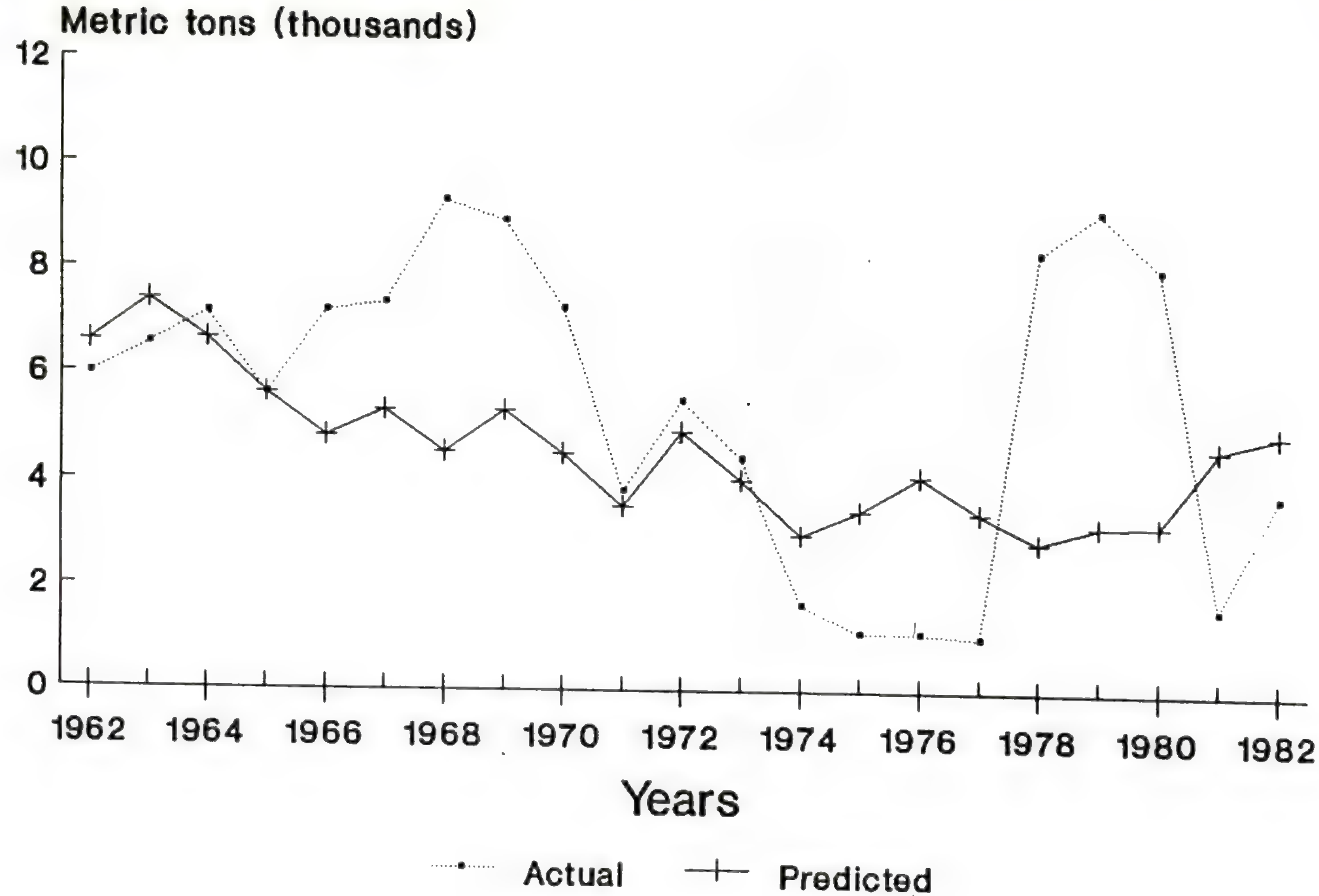

FIGURE 6.23

CANADIAN DEMAND FOR NON-E.E.C. W. EUROPEAN FRESH VEGETABLES.

Predicted E.E.C. demands for Latin American, U.S., Canadian, Far Eastern, African, and Non-E.E.C. Western European vegetables are illustrated in Figures 6.24 through 6.29. The E.E.C. is the largest import market for fresh vegetables, therefore it is important to have a clear picture of how well the model predicts its individual product demands. In all cases, the general trends are captured quite well. The model is particularly accurate in the cases of E.E.C. demand for U.S., Far Eastern, and African vegetables, three of the E.E.C.'s most important product demands. Its moderate growth in demand for U.S. vegetables is illustrated in Figure 6.25, the dramatic growth in the E.E.C.'s demand for Far Eastern vegetables in Figure 6.27, and the decline in its demand for African vegetables in 6.28. The model clearly does a very good job in predicting these very important patterns of trade.

Middle Eastern demands for U.S., E.E.C., African, and Non-E.E.C. Western European vegetables are predicted in Figures 6.30 through 6.33. The Middle East is one of the fastest growing import markets for fresh vegetables, hence it is important to see how well the model predicts its product demands. In each of these four cases, its predicted values closely match the actual values. This indicates that the model could be a useful tool for policy makers to predict Middle Eastern demands for vegetable products in the near future. It could be helpful in giving some indication

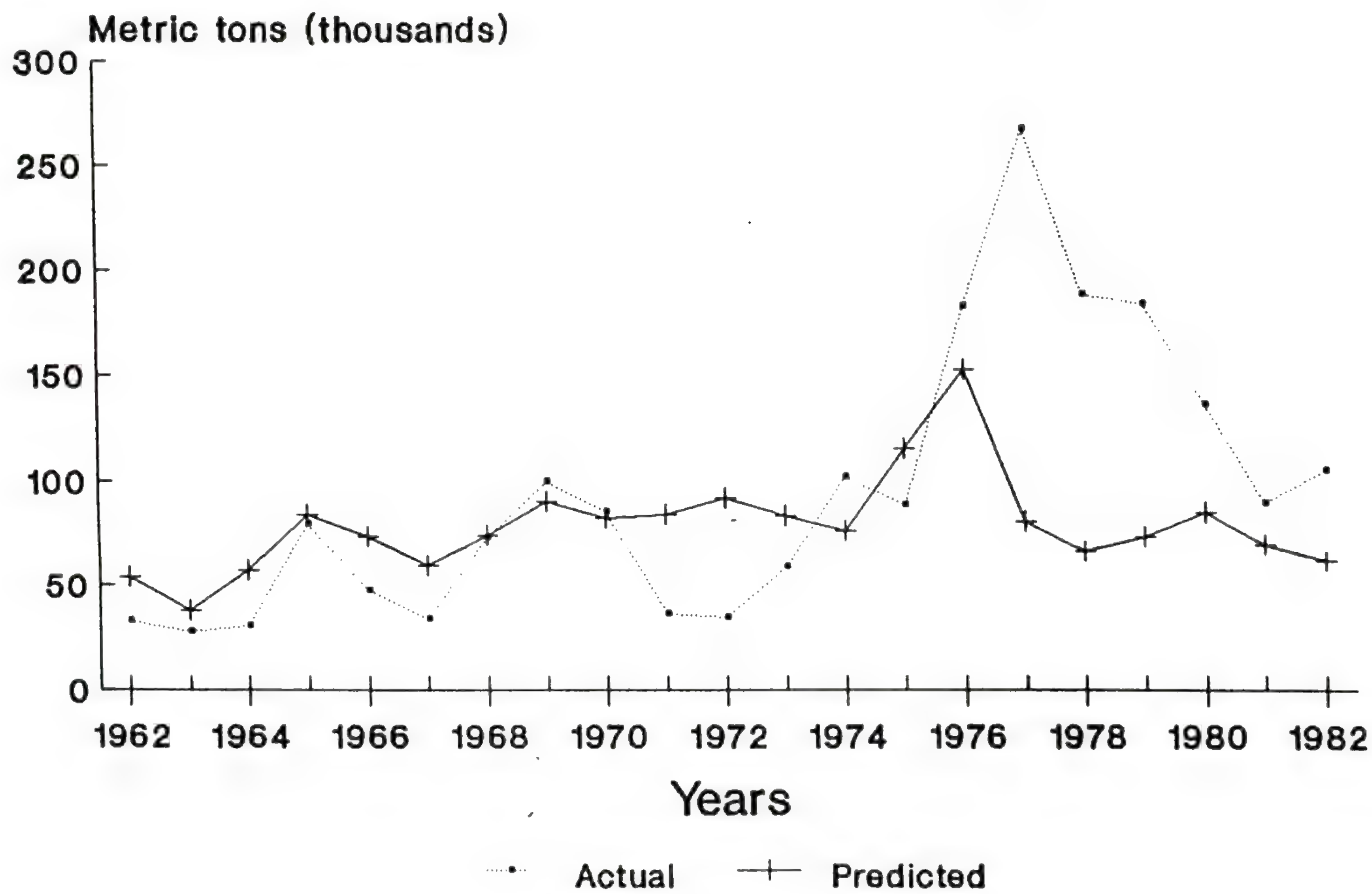

FIGURE 6.24

E.E.C. DEMAND FOR LATIN AMERICAN FRESH VEGETABLES.

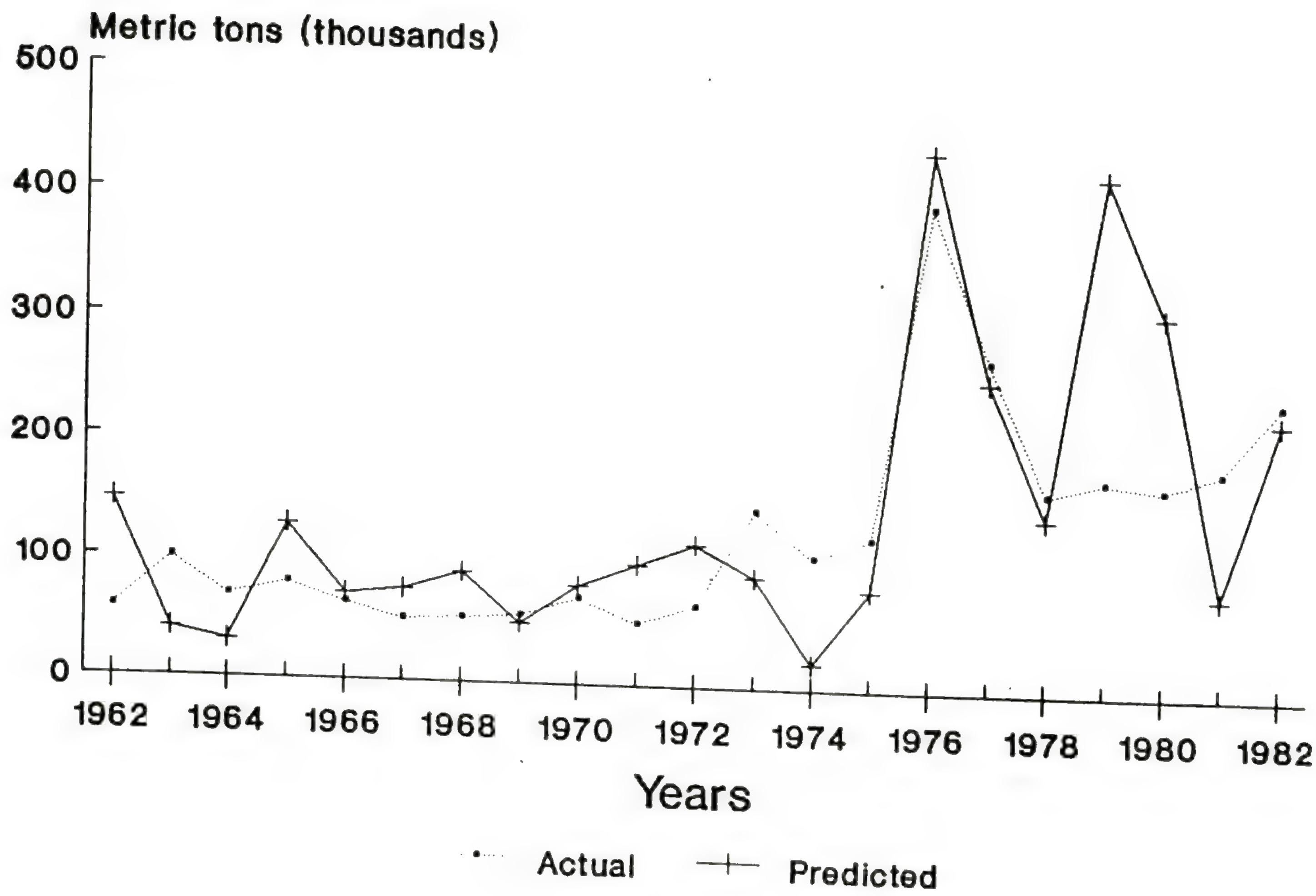

FIGURE 6.25

E.E.C. DEMAND FOR U.S. FRESH VEGETABLES.

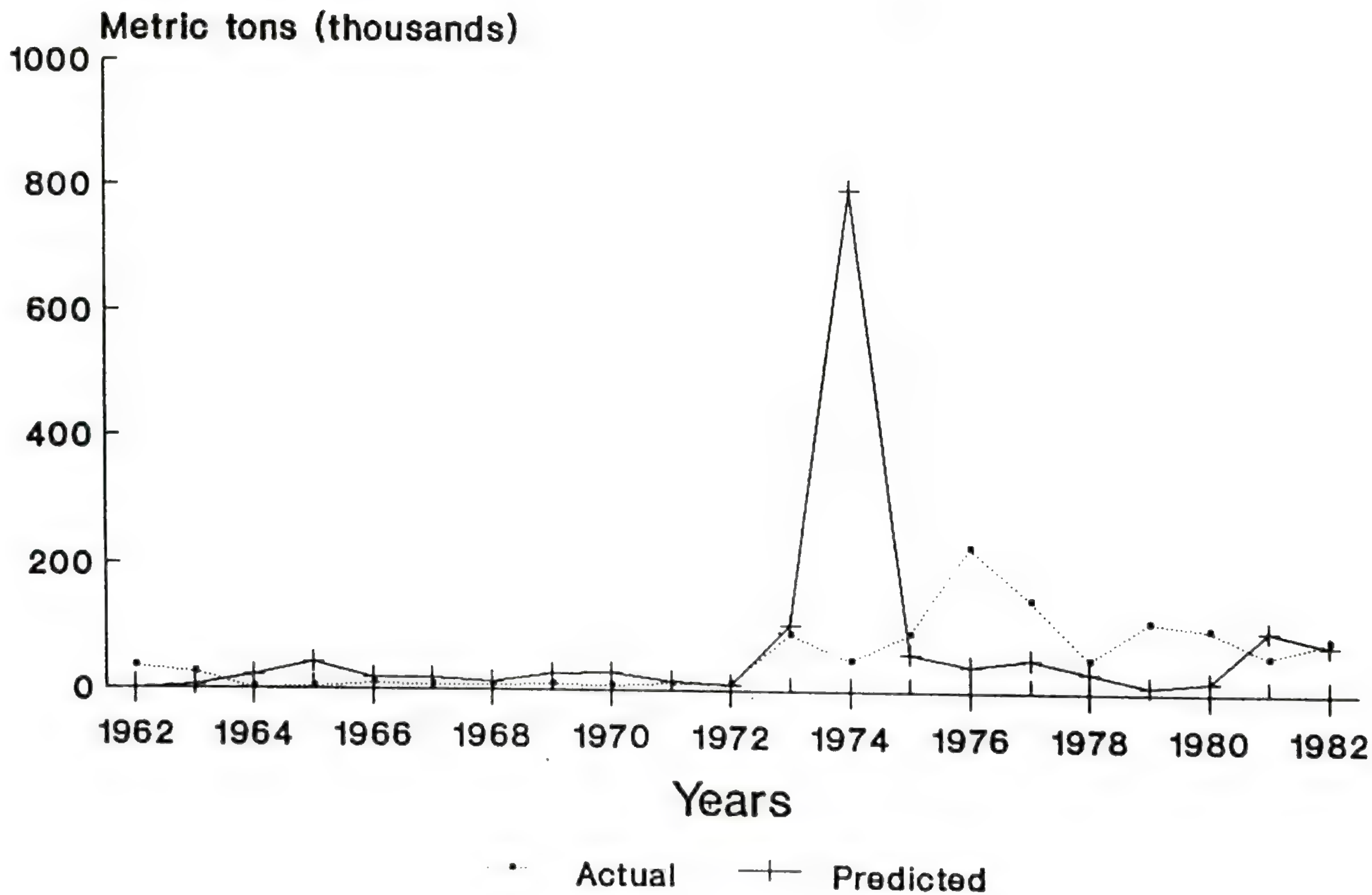

FIGURE 6.26

E.E.C. DEMAND FOR CANADIAN FRESH VEGETABLES.

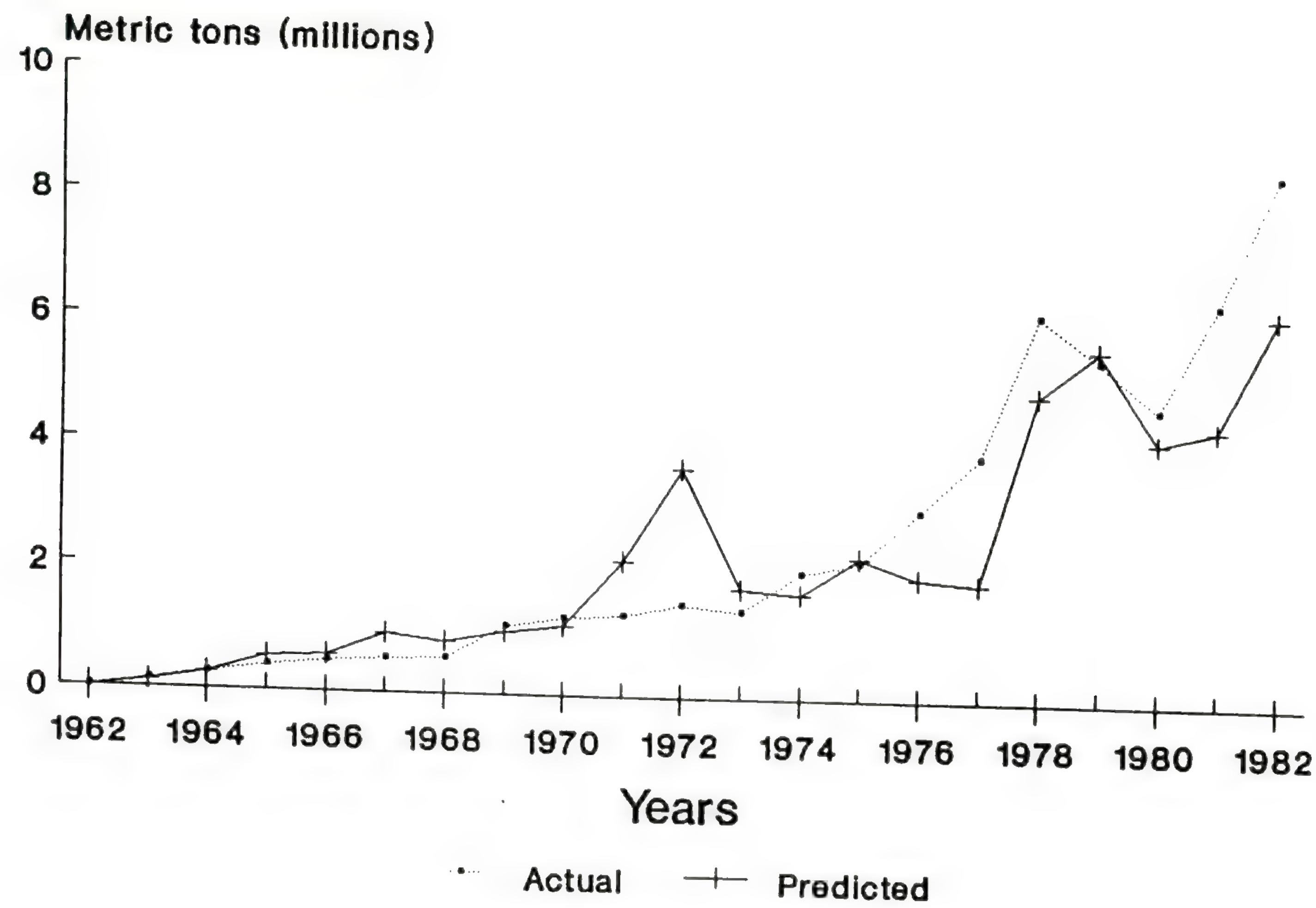

FIGURE 6.27

E.E.C. DEMAND FOR FAR EASTERN FRESH VEGETABLES.

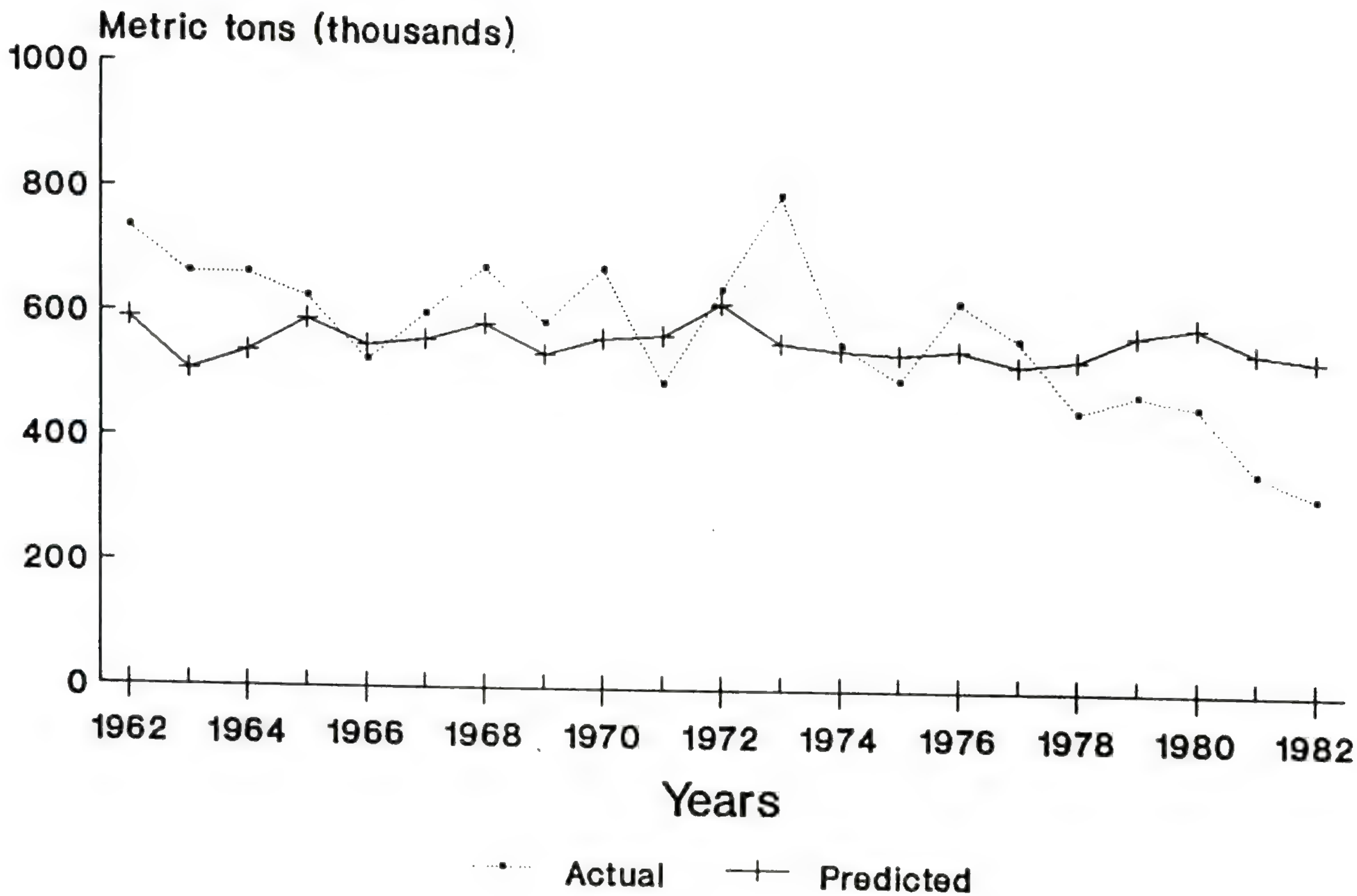

FIGURE 6.28

E.E.C. DEMAND FOR AFRICAN FRESH VEGETABLES.

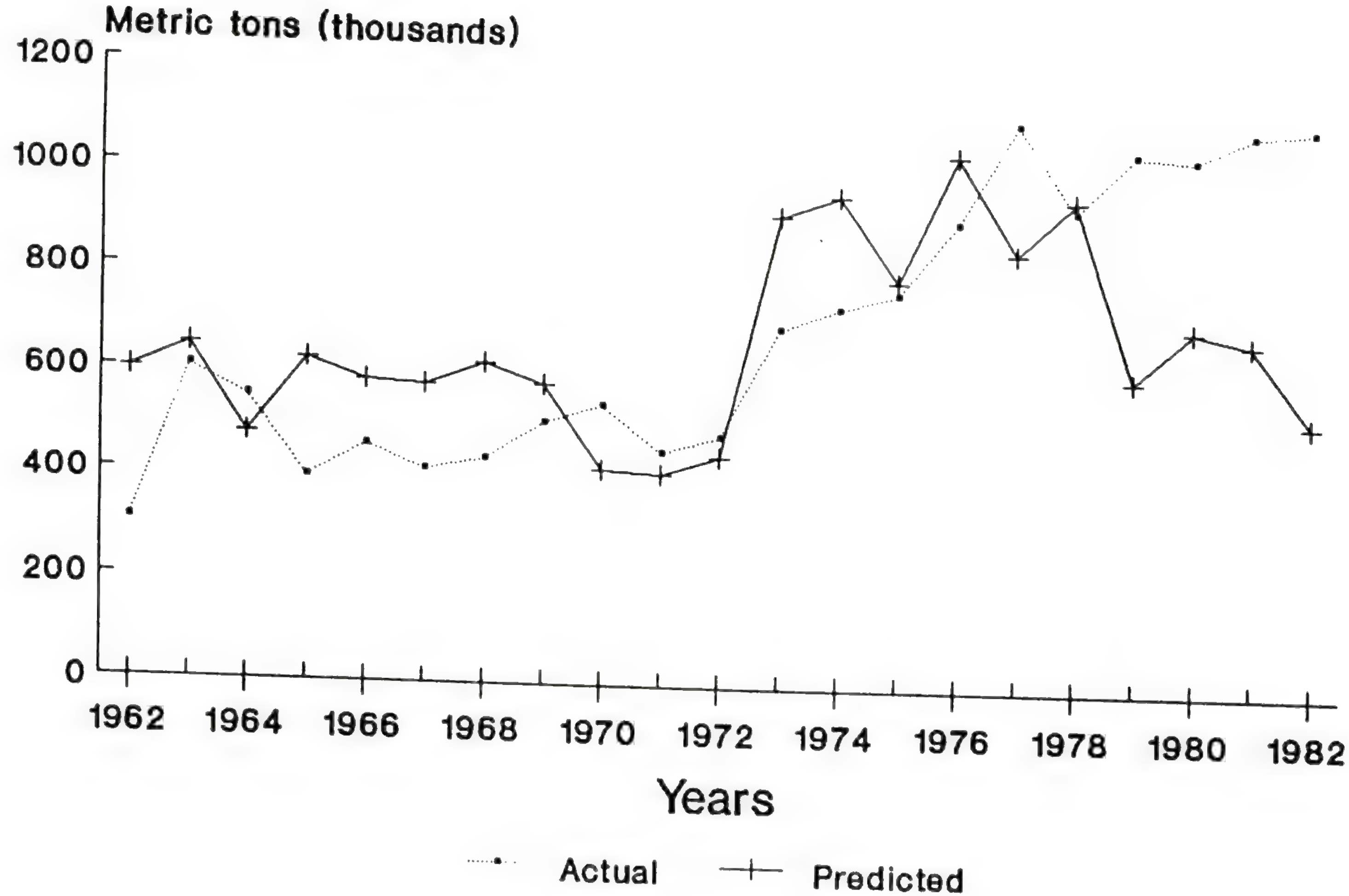

FIGURE 6.29

E.E.C. DEMAND FOR NON-E.E.C. W. EUROPEAN FRESH VEGETABLES.

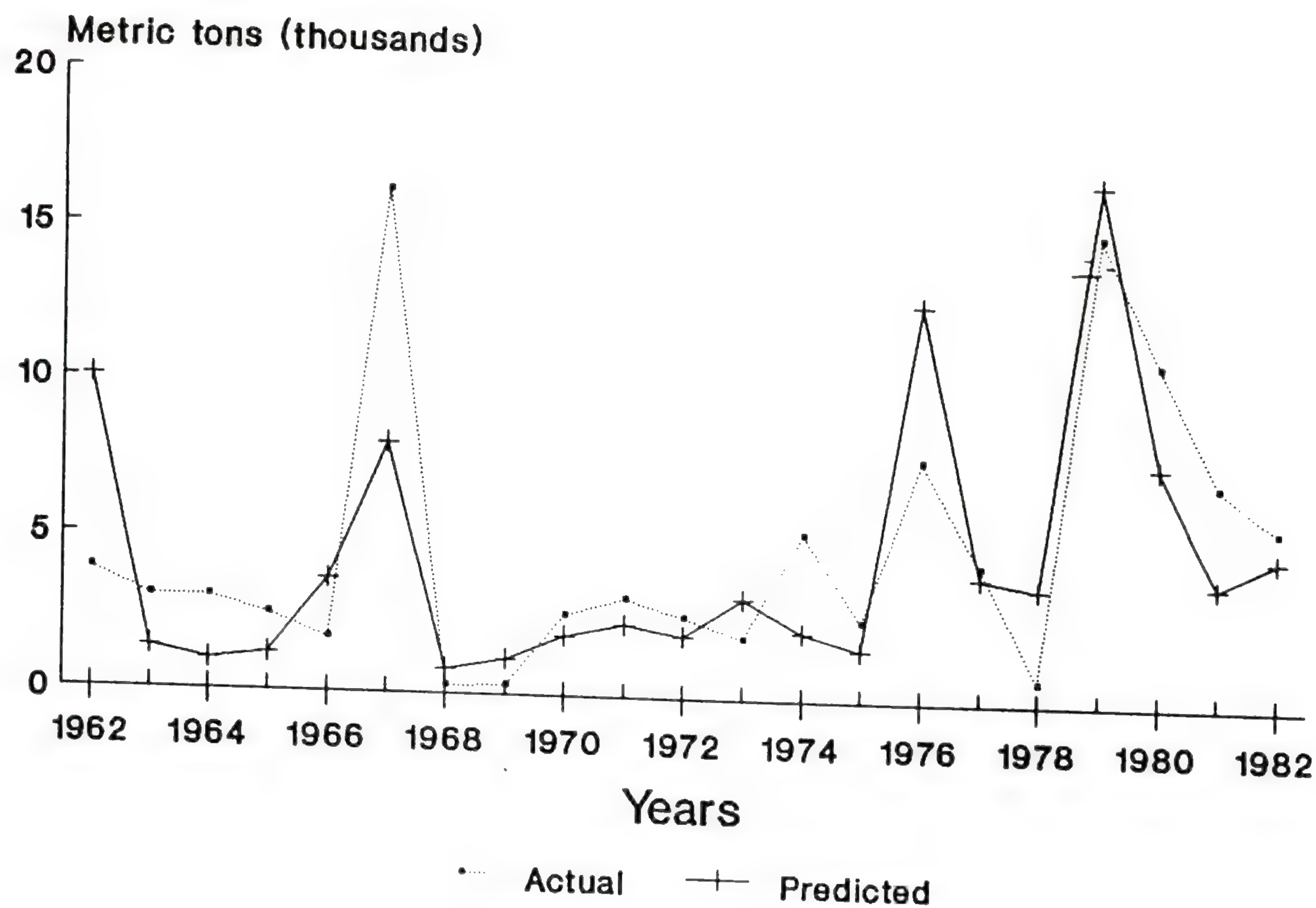

FIGURE 6.30

MIDDLE EASTERN DEMAND FOR U.S. FRESH VEGETABLES.

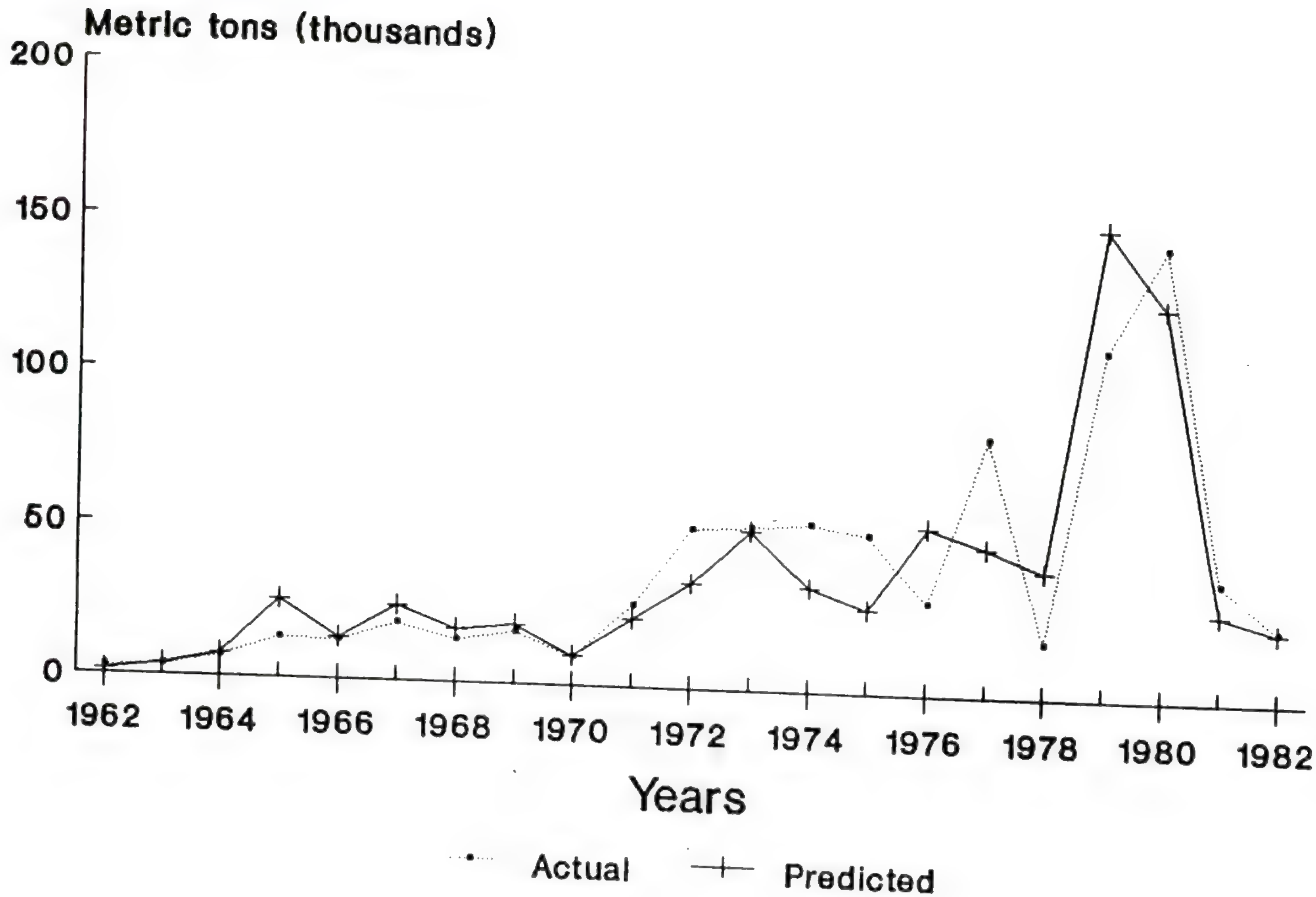

FIGURE 6.31

MIDDLE EASTERN DEMAND FOR E.E.C. FRESH VEGETABLES.

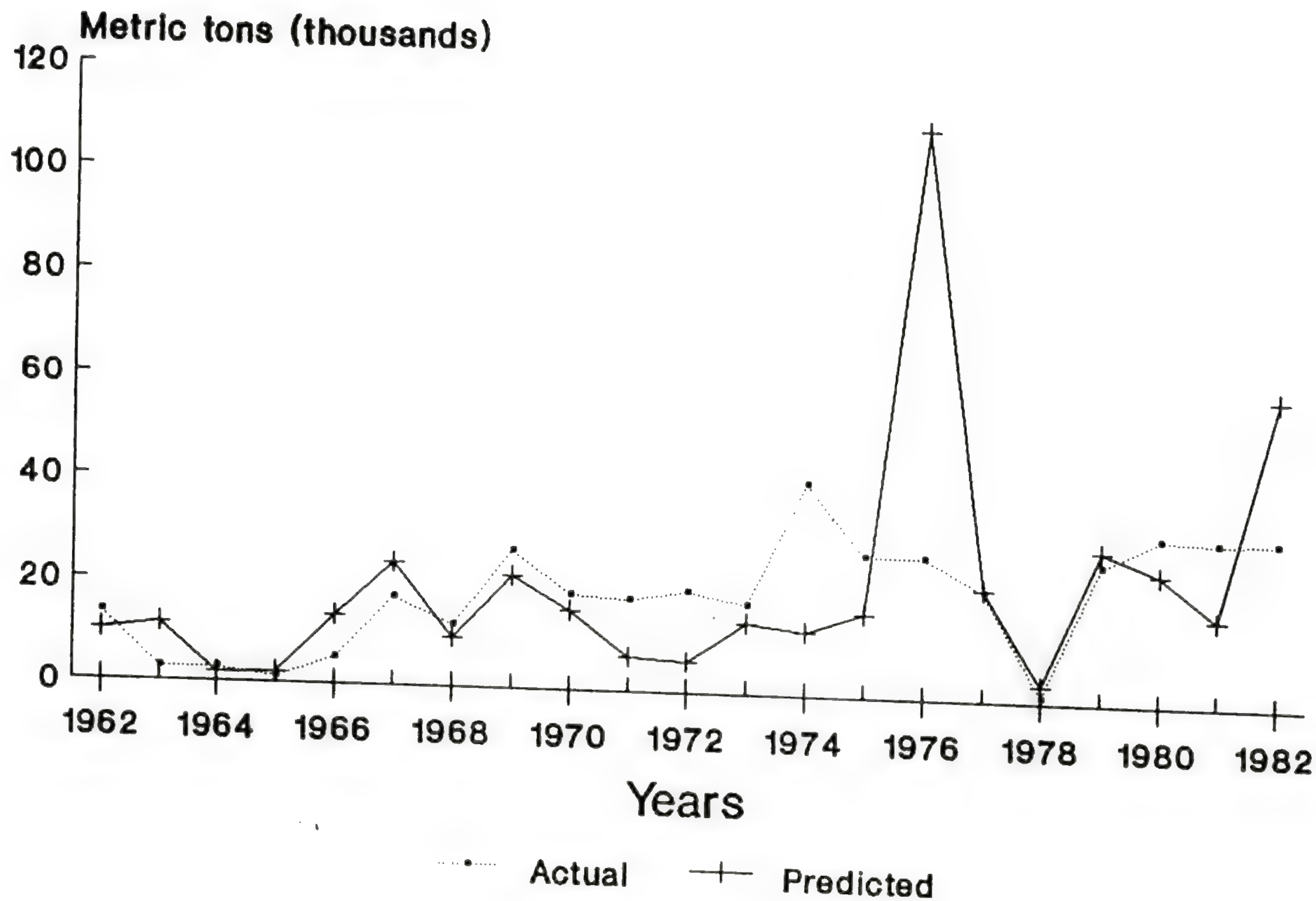

FIGURE 6.32

MIDDLE EASTERN DEMAND FOR AFRICAN FRESH VEGETABLES.

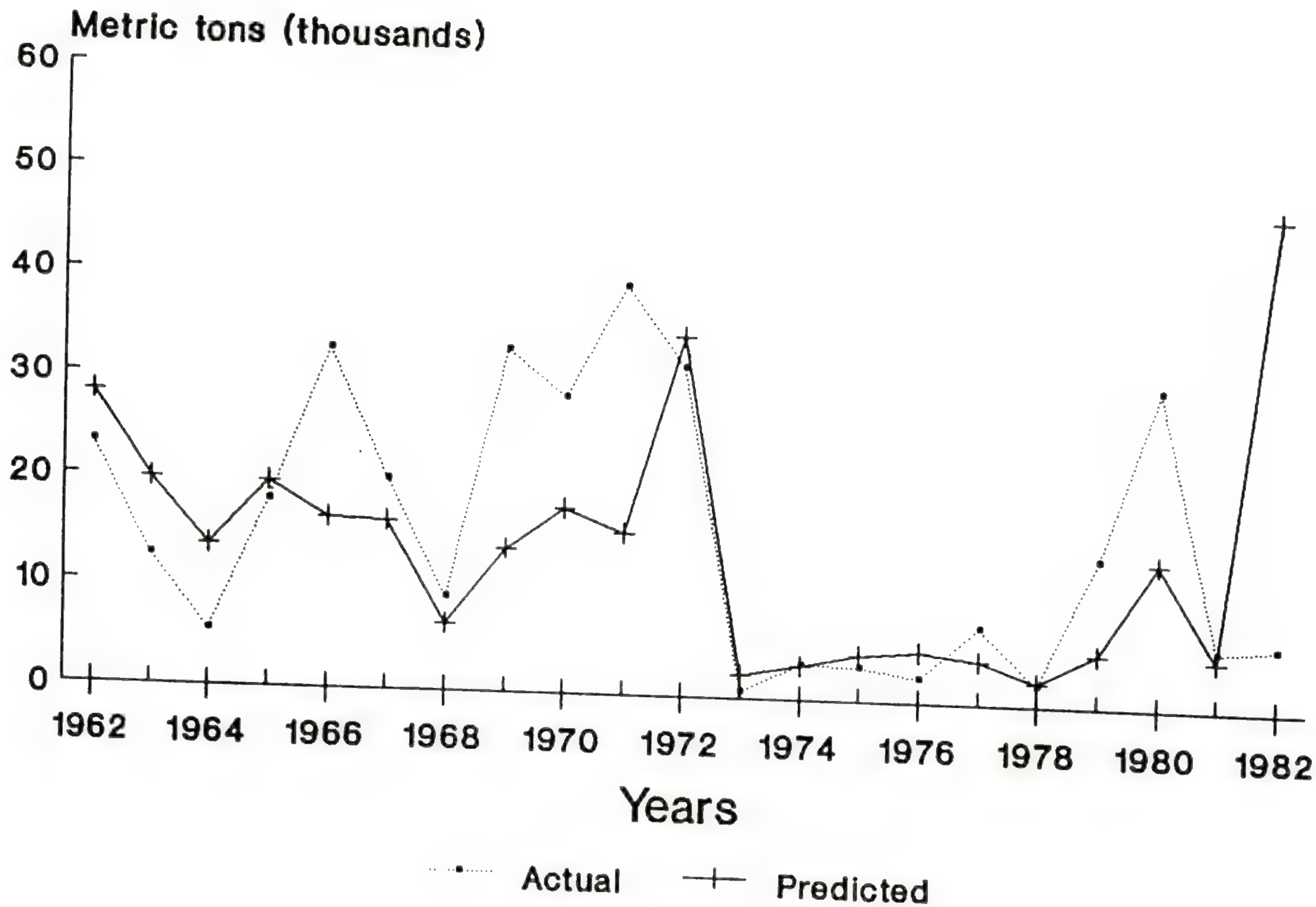

FIGURE 6.33

MIDDLE EASTERN DEMAND FOR NON-E.E.C. W. EUROPEAN FRESH VEGETABLES.

of the potential for the U.S. to increase its exports to this region and the potential competition posed by the E.E.C., Africa, and the Non-E.E.C. Western European region.

Far Eastern demands for U.S., Middle Eastern, and E.E.C. fresh vegetables are illustrated in Figures 6.34 through 6.36. These are also quite accurate, with the exception of that for the Middle East. The Far East is a growth region and the U.S. and the E.E.C. are competing for shares in that market. The predictive ability of the model for the Far East's demands for these products is very good. The model could be a useful tool for policy makers in predicting these demands in the near future.

African demands for E.E.C. and Middle Eastern vegetables are illustrated in Figures 6.37 and 6.38. Again, they are quite accurate. As Africa is also a growth region in terms of its import market, the model could be useful in predicting product demands, and hence market shares, in the near future.

The Non-E.E.C. Western European region's demands for Latin American, U.S., Canadian, E.E.C., Middle Eastern, and African fresh vegetables are illustrated in Figures 6.39 and 6.44. In general, while the major trends are captured, these product demands are not predicted as accurately as those for other regions. The exceptions to this are the Non-E.E.C. Western European region's demand for E.E.C. vegetables, and to a lesser extent those for Canada, the

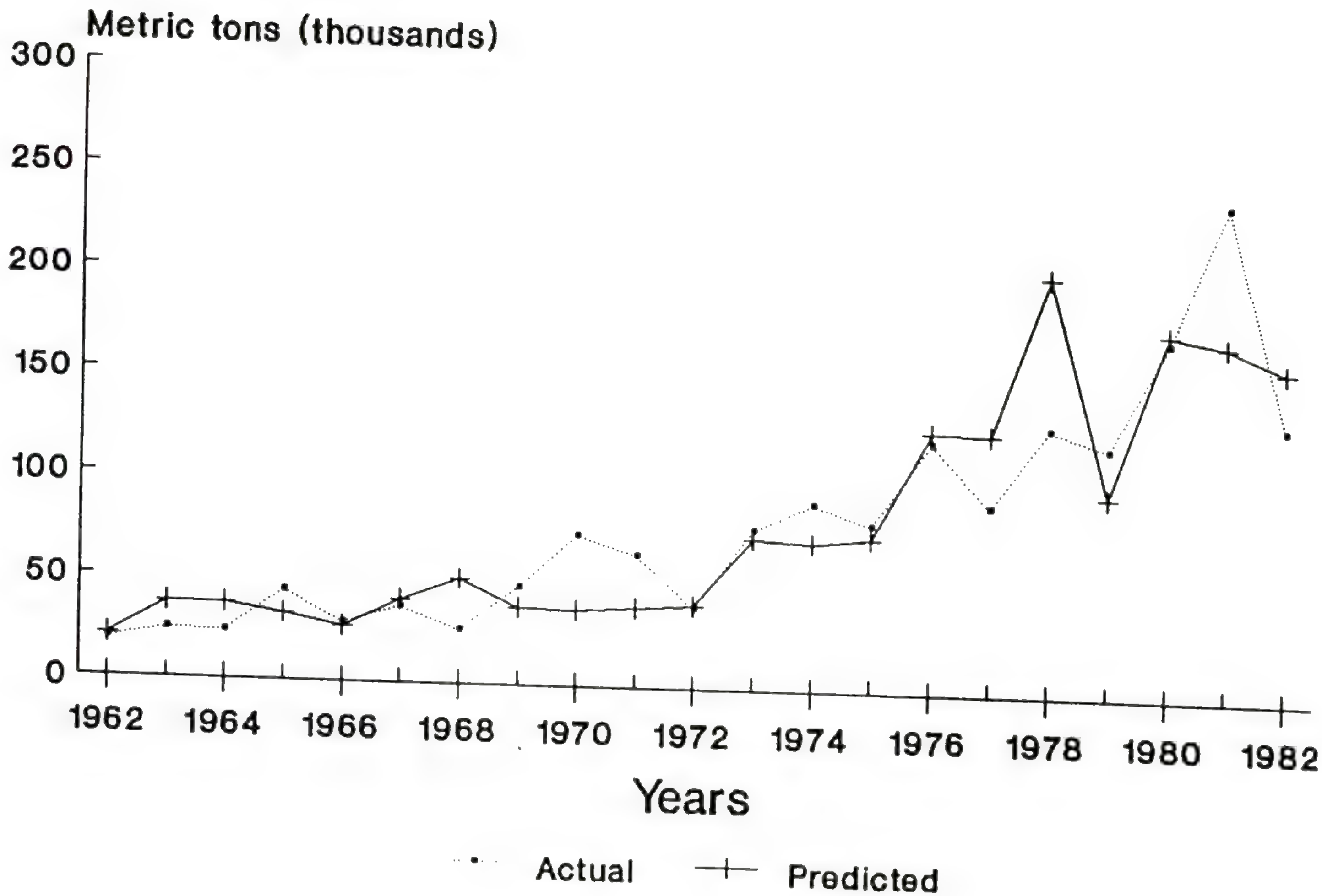

FIGURE 6.34

FAR EASTERN DEMAND FOR U.S. FRESH VEGETABLES.

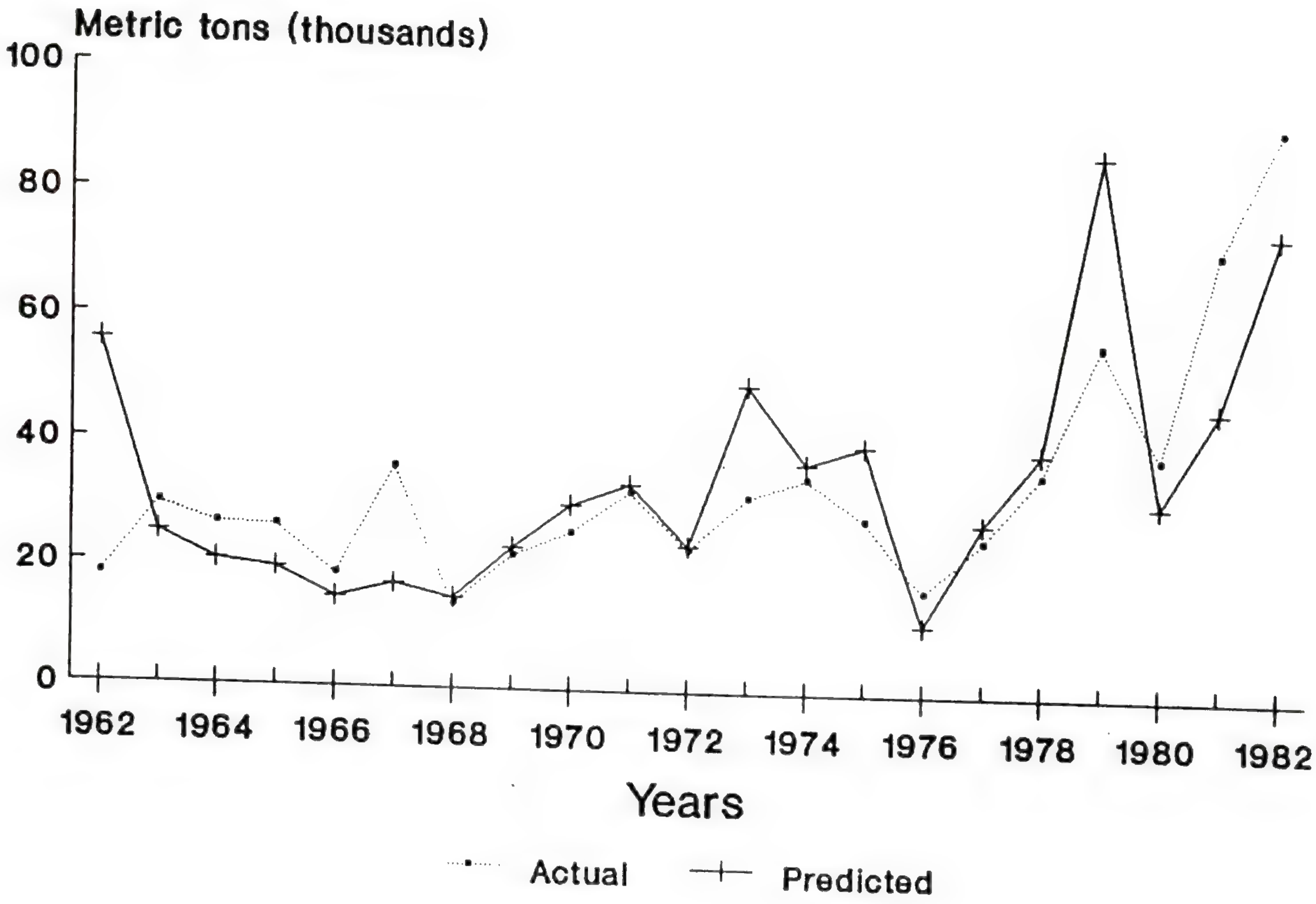

FIGURE 6.35

FAR EASTERN DEMAND FOR E.E.C. FRESH VEGETABLES.

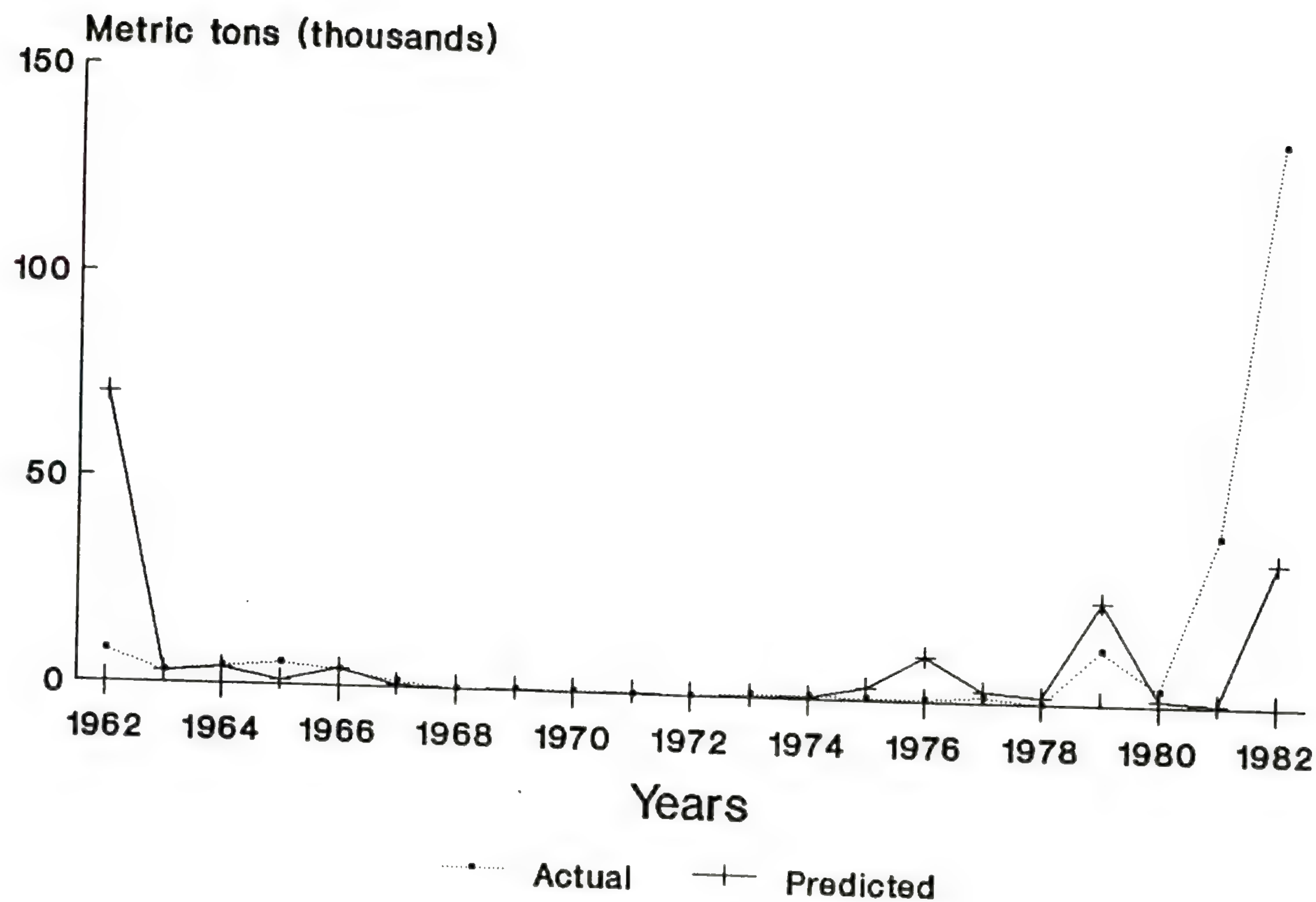

FIGURE 6.36

FAR EASTERN DEMAND FOR MIDDLE EASTERN FRESH VEGETABLES.

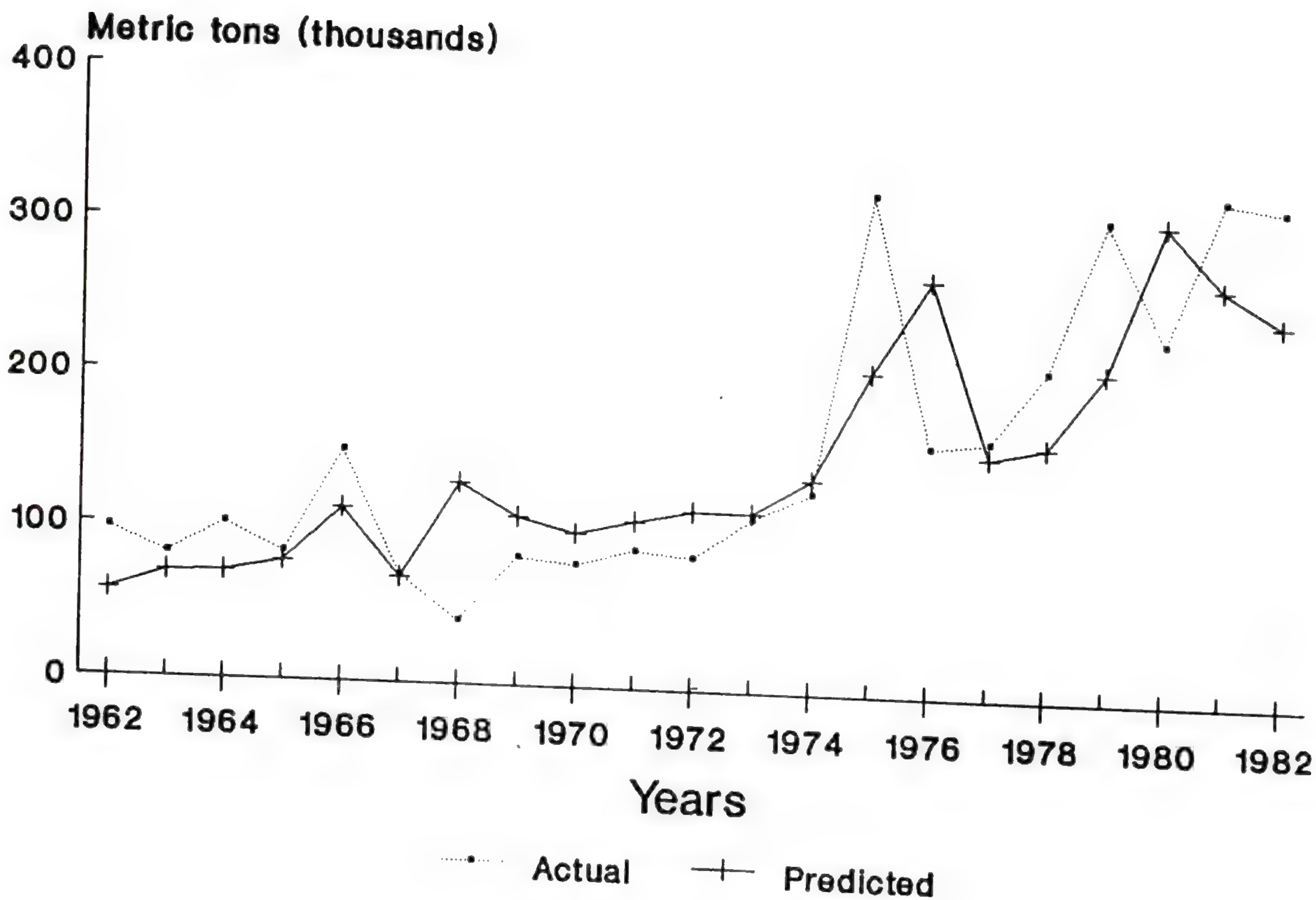

FIGURE 6.37

AFRICAN DEMAND FOR E.E.C. FRESH VEGETABLES.

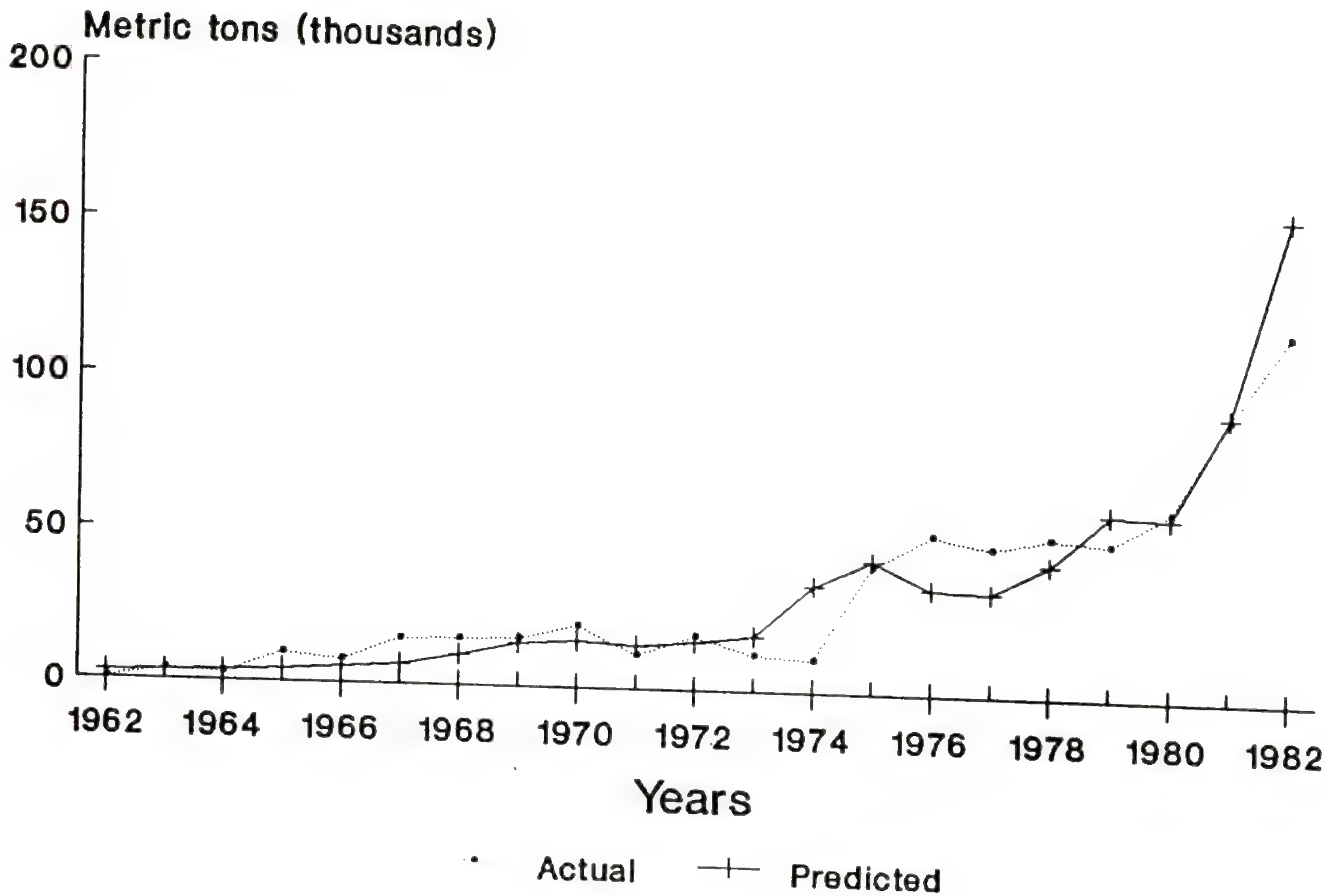

FIGURE 6.38

AFRICAN DEMAND FOR MIDDLE EASTERN FRESH VEGETABLES.

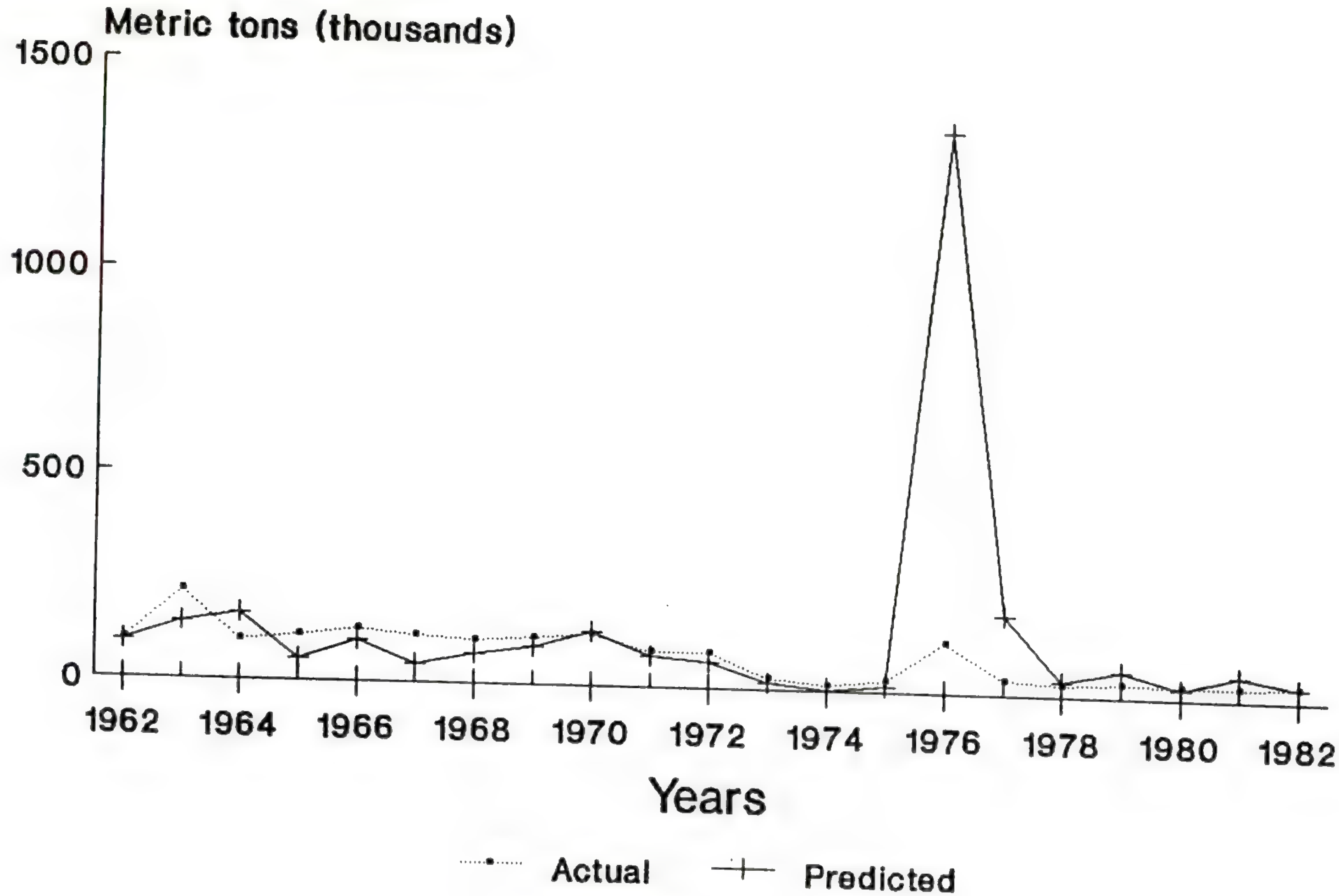

FIGURE 6.39

NON-E.E.C. W. EUROPEAN DEMAND FOR LATIN AMERICAN FRESH VEGETABLES.

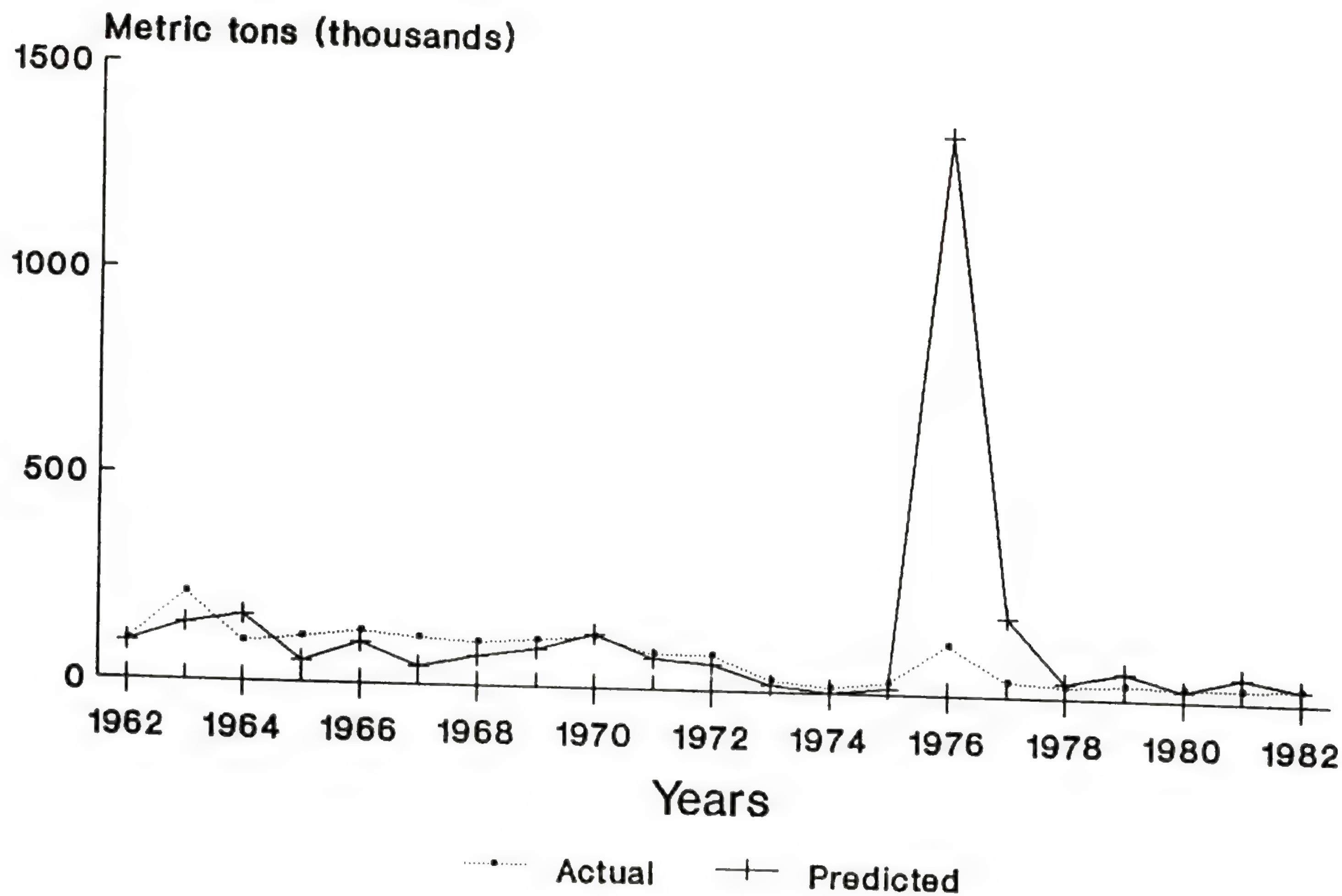

FIGURE 6.40

NON-E.E.C. W. EUROPEAN DEMAND FOR U.S. FRESH VEGETABLES.

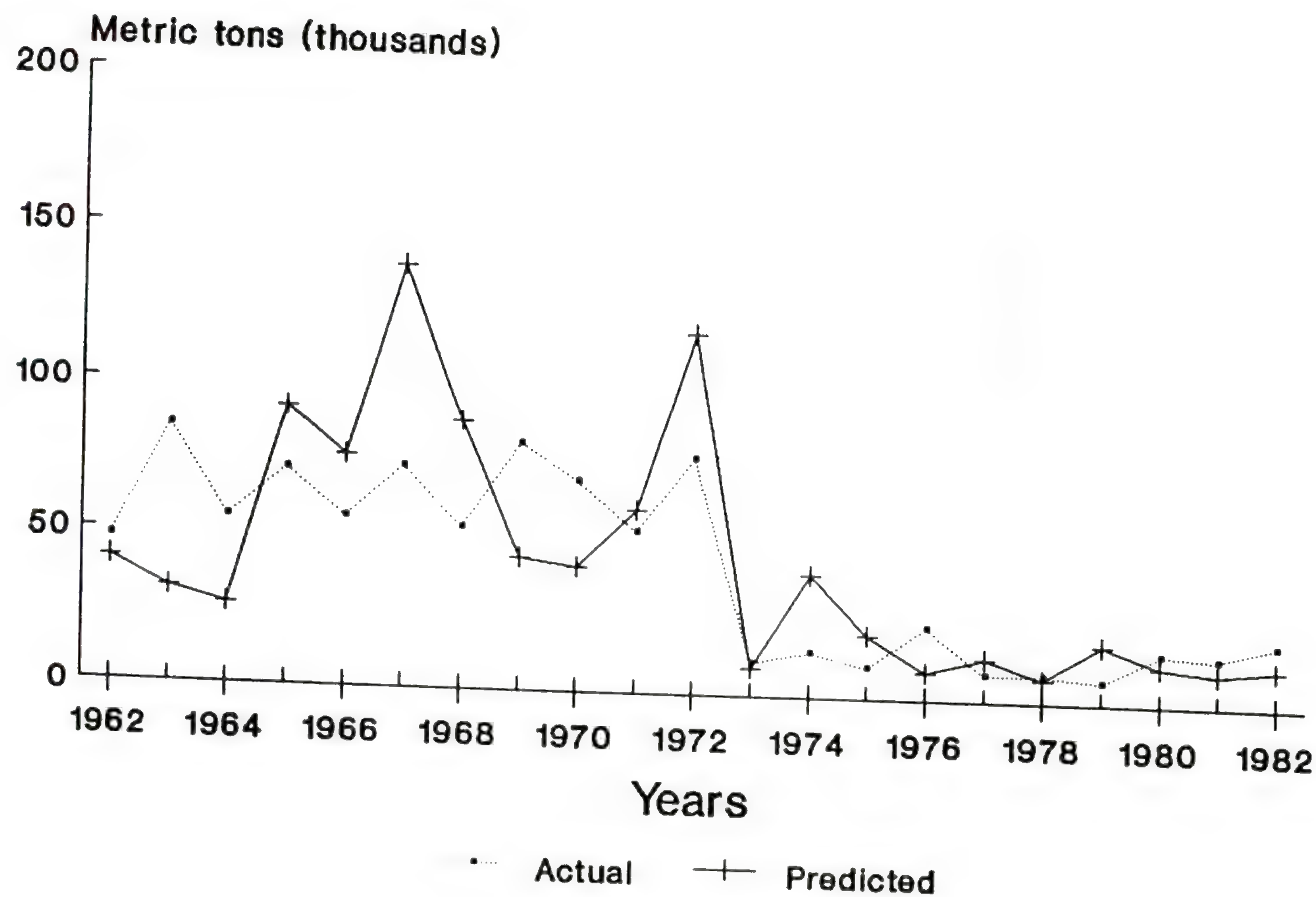

FIGURE 6.41

NON-E.E.C. W. EUROPEAN DEMAND FOR CANADIAN FRESH VEGETABLES.

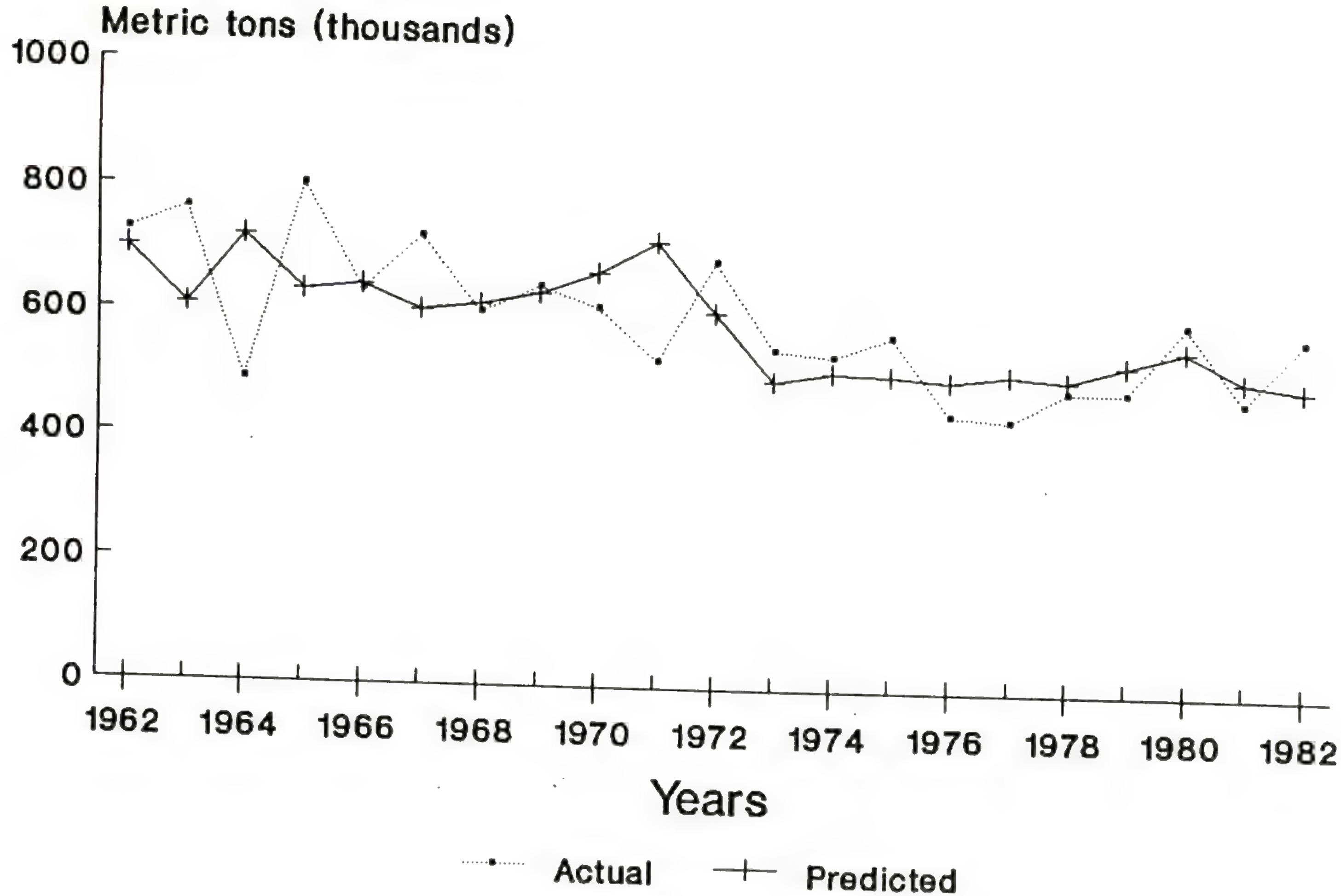

FIGURE 6.42

NON-E.E.C. W. EUROPEAN DEMAND FOR E.E.C. FRESH VEGETABLES.

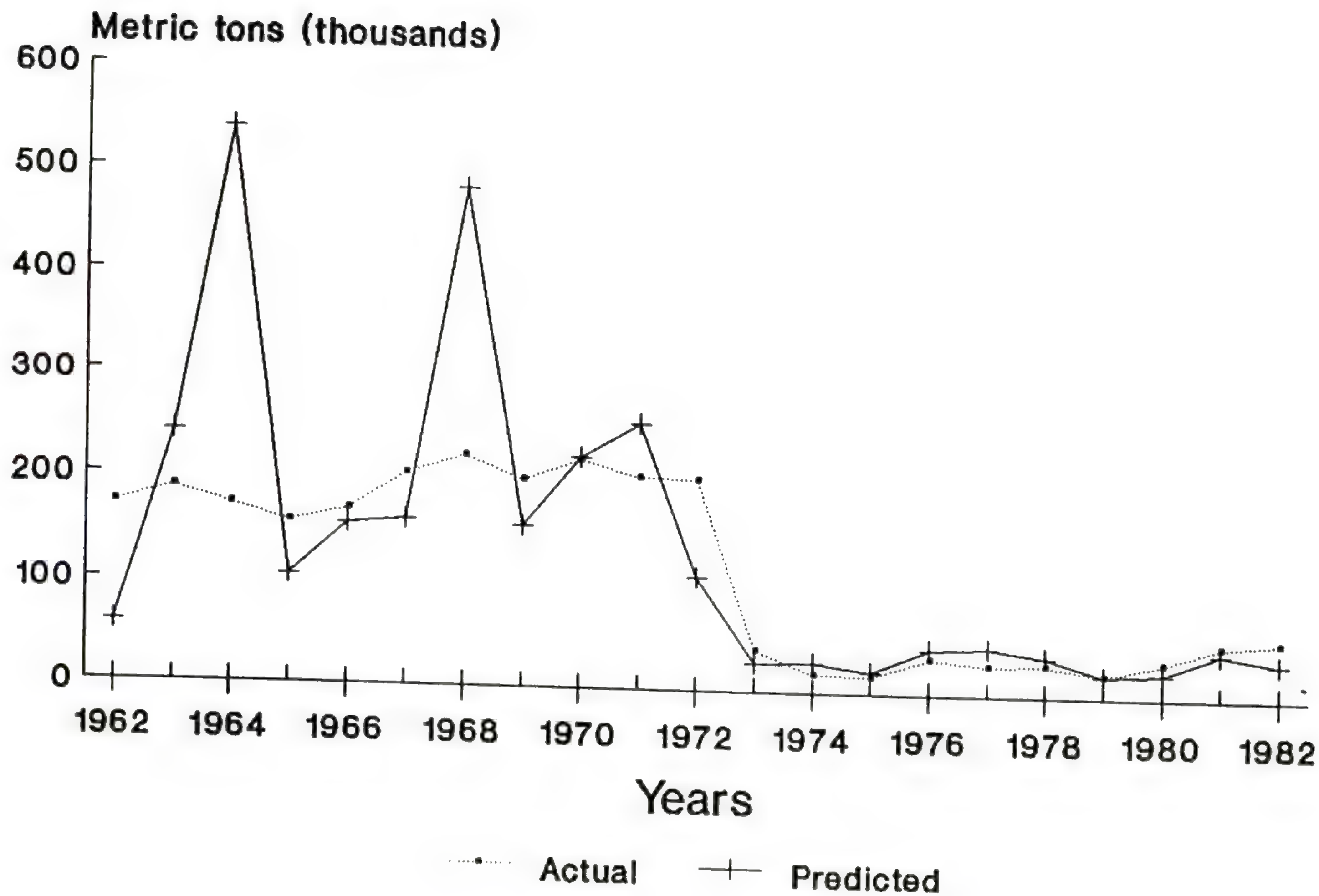

FIGURE 6.43

NON-E.E.C. W. EUROPEAN DEMAND FOR MIDDLE EASTERN FRESH VEGETABLES.

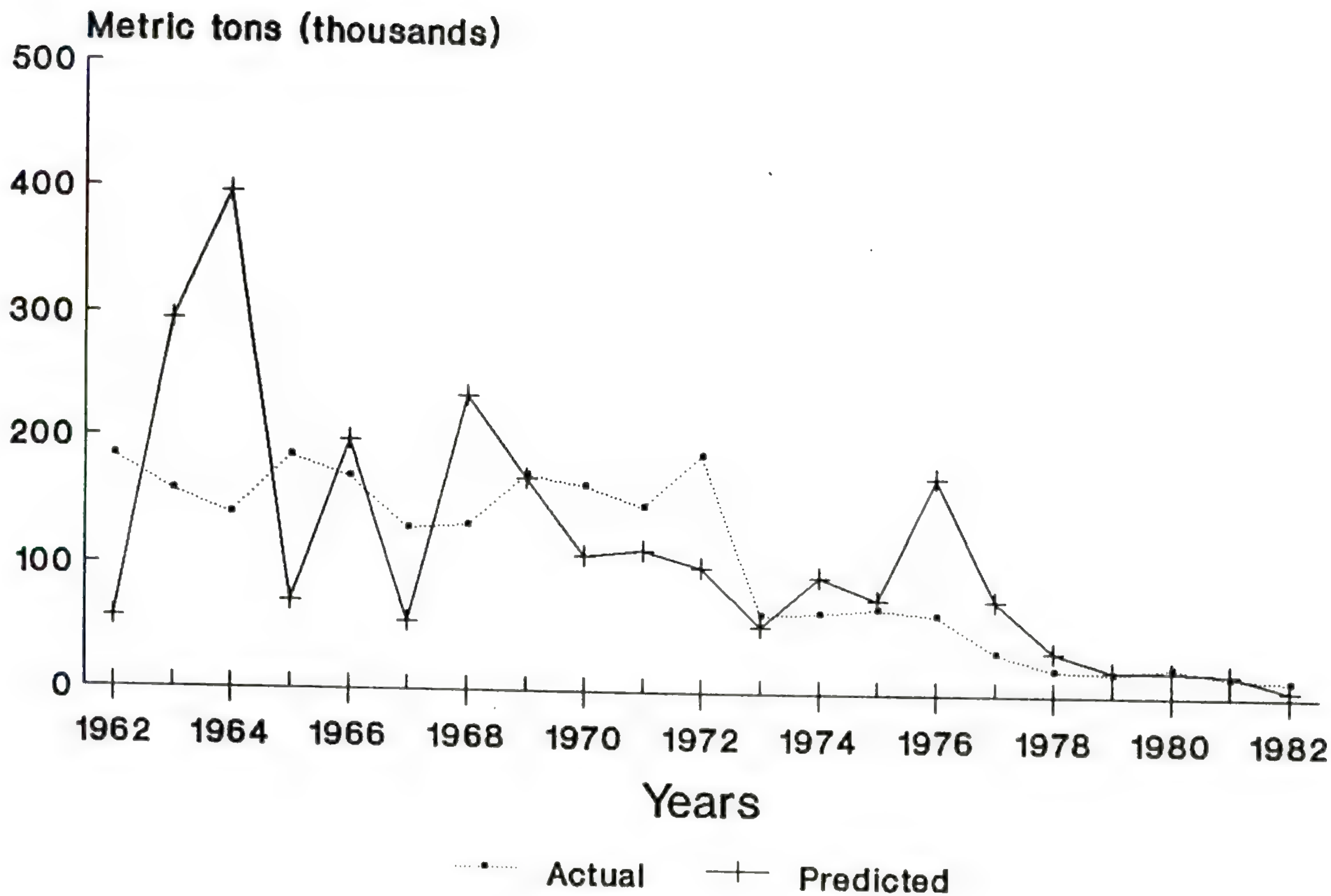

FIGURE 6.44

NON-E.E.C. W. EUROPEAN DEMAND FOR AFRICAN FRESH VEGETABLES.

Middle East, and Africa. There appear to be data problems in 1976 for Latin America and the U.S., as both show major outliers for this year.

In general, Figures 6.1 through 6.44 graphically illustrate that the model constructed to explain international trade in fresh vegetables does its job quite well. In all cases, the general trends are captured and most relationships are predicted quite accurately. It appears that the model could be used by policy makers to predict all of these relationships in the near future. This would give valuable insights into possible expansion of U.S. participation in all aspects of this trade, its import market demand, export supply, product demands, and other regions' demands for its vegetables.

Statistics Indicating the Fit and Performance of the Model

In general, the results of the estimation are good in that they make economic sense and generally correspond to what one would expect given the trading situation as described in earlier chapters (see Figures 6.1 through 6.44 and Tables 6.1 through 6.4). The Durbin Watson statistics are usually close to two, indicating little serial correlation and a well specified model. Given the annual data, any evidence of serial correlation would most likely be due to model mispecification. The R square statistics range from quite low , close to zero , to quite high , close

TABLE 6.1

MARKET DEMAND EQUATIONS FOR ALL REGIONS.

Region	DW	R^2	F	%RMS	Theil Inequality Coefficients
Latin America	1.761	.635	9.845	0.4	0.001868
U.S.	2.890	.871	38.202	0.3	0.001350
Canada	1.913	.808	23.835	0.5	0.002436
E.E.C.	1.181	-.373	.	0.5	0.002429
Middle East	1.817	-.234	.	3.4	0.016710
Far East	2.215	.790	21.237	0.3	0.001426
Africa	1.217	.993	827.500	0.1	0.000388
Non-E.E.C. W. Europe	1.151	.257	1.960	0.3	0.001481

TABLE 6.2

EXPORT SUPPLY EQUATIONS FOR ALL REGIONS.

Region	DW	R^2	F	%RMS	Theil Inequality Coefficients
Latin America	1.027	.857	54.241	1.3	0.006653
U.S.	2.306	.481	8.351	1.4	0.007051
Canada	2.139	.692	20.234	1.2	0.006017
E.E.C.	2.376	.336	4.553	1.0	0.004790
Middle East	1.640	.750	26.978	1.3	0.006488
Far East	2.536	.103	1.034	9.3	0.048198
Africa	0.843	.743	25.979	1.0	0.004975
Non-E.E.C. W. Europe	2.088	.915	97.340	0.8	0.003939

TABLE 6.3

DURBIN WATSON AND R^2 STATISTICS FOR ALL PRODUCT DEMANDS.

Regions	---Partner Regions---							
	Latin America	U.S.	Canada	E.E.C.	Middle East	Far East	Africa	Non-E.E.C. W. Europe
Latin America	. .	. .	1.776 - 0.005	1.133 0.054	1.165 0.110	2.248 0.133	1.178 0.141	1.262 0.566
U.S.	1.259 0.781	. .	. .	2.134 0.030	1.273 0.544	1.892 0.473	1.062 0.309	2.081 -1.724
Canada	0.671 0.454	1.458 0.857	. .	. .	1.034 0.245	2.050 0.362	2.512 0.023	1.070 0.103
E.E.C.	0.619 0.234	1.599 -0.122	1.024 -0.437	. .	. .	0.849 0.945	0.589 0.042	0.759 0.209
Middle East	1.870 - 0.172	1.907 0.485	2.348 0.550	2.136 0.850	. .	. .	1.745 0.500	1.287 0.530
Far East	1.079 0.002	1.527 0.784	2.037 0.019	1.455 0.274	1.163 0.306	. .	. .	1.886 0.458
Africa	2.205 0.852	1.408 0.790	1.743 0.663	1.609 0.576	1.276 0.812	0.582 0.463	. .	. .
Non-E.E.C. W. Europe	. .	1.348 -0.333	1.862 0.524	2.652 0.189	1.877 0.734	1.513 0.151	1.824 0.518	. .

TABLE 6.4

% RMS AND THEIL INEQUALITY COEFFICIENTS FOR ALL PRODUCT DEMANDS.

Regions	---Partner Regions---							
	Latin America	U.S.	Canada	E.E.C.	Middle East	Far East	Africa	Non-E.E.C. W. Europe
Latin America	. .	. .	13.50 0.052190	5.90 0.029690	51.30 0.153250	22.80 0.085836	14.60 0.0606480	3.70 0.018737
U.S.	1.80 0.009011	. .	. .	2.10 0.010214	20.60 0.085246	8.70 0.042426	7.90 0.037624	10.60 0.053069
Canada	2.30 0.011489	0.60 0.003028	. .	. .	199.70 0.188976	9.40 0.041808	19.00 0.083364	9.20 0.042709
E.E.C.	5.20 0.026071	.52 0.028064	15.40 0.073968	. .	. .	2.80 0.013678	1.70 0.008348	2.70 0.013396
Middle East	78.00 0.174059	11.40 0.048559	19.60 0.077979	4.00 0.019798	. .	. .	8.21 0.038925	8.71 0.040821
Far East	16.39 0.079198	3.34 0.016184	66.21 0.149591	3.81 0.018708	24.29 0.106145	. .	. .	8.38 0.041139
Africa	71.36 0.085418	13.45 0.048074	18.30 0.087688	4.09 0.019233	6.69 0.027596	19.56 0.077776	. .	. .
Non-E.E.C. W. Europe	. .	7.45 0.036884	5.85 0.028676	1.18 0.005902	4.39 0.022709	15.51 0.068076	5.65 0.028500	. .

to one. In general, those for the CIF import price and export supply equations are closer to one than those for the market and product demand equations. This indicates that the functional specifications for the CIF prices and export supplies capture more of the fluctuation in those variables than do those for market and product demands. The R square values for the market demands are generally higher than those for the product demands.

Some of the R square statistics are negative, which is theoretically impossible. This is the result of using a highly restrictive, nonlinear model. In this situation the R square statistics give some signals as to the explanatory power of the individual equations, but they are not valid for statistical tests.

The error sums of squares range from very high, over 100, to very low, less than one. When the SSE's are high, indicating that a large amount of variation is unexplained by the functional relationships and thus delegated to the error terms, the R squares are low. Following a similar pattern as that revealed by the R square values, the SSE's are lowest for the export supply and market demand equations, followed by the CIF import prices and highest for the product demands.

Because R square statistics are not as useful for a restricted, nonlinear model as they are for an unrestricted linear one, some other statistics are necessary to evaluate

the performance of the fresh vegetable trade model. The two that will be used are the root mean square percent error and the Theil inequality coefficient.

The root mean square percent error measures the percent deviation of predicted endogenous variables from the actual data points when the model is used to simulate the values of the endogenous variables over the time period covered by the data. The root mean square, rms, percent error, is defined as:

$$1/T \ \Sigma_t^T \ \{Y(s) - Y(a) \ / \ Y(a)\}^2$$

where

Y(s) = simulated value of Y

Y(a) = actual value of Y

T = number of periods in the simulation

The smaller the percentage root mean square error, the smaller the difference between the simulated value and the actual data value for an endogenous variable.

A drawback of the percentage root mean square error is, however, that there are no limits on its size. If the actual data value is small, then a small error in predicting its value will lead to a large percentage error. If, on the other hand, the actual data value is large, the same size error in predicting its value will lead to a small percentage root mean square error. Therefore, it is not possible to know if the model is making large or small

errors in its predictions by examining percentage root mean square errors.

The percentage root mean square errors for the market demand equations are presented in Table 6.1, those for export supply equations in 6.2, product demands in 6.4, and CIF import prices in 6.6. By far the lowest occur in the market demand equations. All of these are less than one, with the exception of the Middle East, which is 3.4. The percentage root mean square errors for the export supply equations are also quite low, less than 1.5 for all regions except the Far East which is 9.3. Those for the product demands are somewhat higher, ranging from a low of 1.7 to a high of 199.7, with most in the more moderate ranges of the teens. The percentage root mean square errors for the CIF product prices are the highest of the four types of equations, ranging from 1.92 to 24288.6. Many of these values are in the hundreds.

Given the fact that the percentage root mean square errors have no way of accounting for the size of the entity whose prediction error they measure, these results are not unexpected. The data used in the estimation of the model reveal that the market demands have the largest values, followed by export supplies, product demands, and the CIF import prices are the smallest among the data. Thus, while comparing the percentage root mean square errors across types of equations is questionable, comparing them across

TABLE 6.5

DURBIN WATSON AND R^2 STATISTICS FOR ALL CIF PRODUCT PRICES.

Regions	---Partner Regions---							
	Latin America	U.S.	Canada	E.E.C.	Middle East	Far East	Africa	Non-E.E.C. W. Europe
Latin America	. .	2.044 0.750	2.053 0.963	2.372 0.977	1.954 0.239	1.343 0.698	1.845 0.876	1.705 0.912
U.S.	1.917 0.567	. .	2.506 0.982	2.238 0.959	2.371 0.444	1.517 -1.269	1.453 0.664	2.034 0.225
Canada	2.400 0.665	2.990 0.970	. .	1.309 0.297	1.312 0.704	2.287 0.036	1.160 0.845	1.270 0.460
E.E.C.	2.097 0.857	1.399 0.971	2.307 0.940	. .	1.605 0.786	2.100 0.913	1.708 0.956	1.132 0.929
Middle East	1.524 0.630	1.920 0.836	2.210 0.681	0.937 0.803	. .	1.050 0.086	1.781 0.730	1.989 0.903
Far East	2.108 0.707	2.214 0.972	2.406 0.294	1.959 0.648	1.011 0.211	. .	1.987 0.915	2.289 0.717
Africa	2.225 0.371	1.675 0.547	0.866 0.178	2.329 0.958	1.293 0.597	1.962 0.136	. .	2.749 0.909
Non-E.E.C. W. Europe	1.674 0.967	1.306 0.967	2.342 0.915	1.558 0.999	0.656 0.913	2.520 0.134	1.411 0.980	. .

TABLE 6.6

% RMS AND THEIL INEQUALITY COEFFICIENTS FOR ALL CIF PRODUCT PRICES.

Regions	---Partner Regions---							
	Latin America	U.S.	Canada	E.E.C.	Middle East	Far East	Africa	Non-E.E.C. W. Europe
Latin America	. .	28.70 0.101434	12.20 0.035683	8.80 0.033341	3683.40 0.291605	133.50 0.198701	195.00 0.090633	85.40 0.084078
U.S.	41.70 0.096904	. .	2.90 0.014700	204.50 0.062504	24288.60 0.286456	443.80 0.393185	173.40 0.157505	355.40 0.510100
Canada	46.90 0.093927	8.60 0.027037	. .	308.20 0.234420	226.90 0.206816	420.00 0.411534	266.00 0.128970	1392.10 0.340635
E.E.C.	20.10 0.076669	13.40 0.036885	10.70 0.057696	. .	13.30 0.067601	5.90 0.025007	14.10 0.048288	19.90 0.054803
Middle East	83.50 0.269253	44.80 0.129168	68.00 0.140187	137.220 0.093848	. .	112.36 0.312511	239.40 0.112366	316.99 0.087682
Far East	196.27 0.181883	10.70 0.037889	159.96 0.207343	707.99 0.171894	105.12 0.222898	. .	63.60 0.087068	43.12 0.127806
Africa	104.21 0.209492	146.74 0.202121	44.36 0.135142	7.40 0.033706	29.68 0.099141	1957.72 0.193170	. .	32.11 0.067346
Non-E.E.C. W. Europe	34.74 0.048678	24.30 0.044972	9.69 0.036023	1.92 0.006048	69.06 0.074041	22.41 0.105199	118.95 0.035876	. .

regions for the same type of relationship can yield useful information. In general, the percentage root mean square errors of this model are smaller for major trade flows and larger for the smaller trade flows.

The percentage root mean square errors measure the predictive ability of the model. Another important consideration of model performance is how well it simulates turning points in the data. It is possible for a model to have a low percentage rms error and yet not duplicate rapid changes in the actual data. It will predict well except for the periods with the major changes. This implies that the model is not explaining the underlying physical process.

A statistic which measures how well a model simulates turning points is the Theil inequality coefficient. This statistic is defined as:

$$U = 1/T \ \Sigma_t^T \{Yp - Ya\}^2 \ / \ 1/T \ \Sigma_t^T \ (Yp)^2 + 1/T \ \Sigma_t^T \ (Ya)^2$$

Note that the numerator is simply the percentage rms error and can be rewritten as:

$$1/T \ \{ \ (Yp)^2 + \ (Ya)^2 \ - 2(YpYa) \ \}$$

The denominator places limits on the behavior of the percentage rms error.

If there is no correlation between the predicted and actual values then:

$$2(YpYa) = 0$$

and

$U = 1$

If there is a positive correlation between the predicted and actual values, then 2(YpYa) >1 and is subtracted from the numerator, which causes U to be <1. The higher the correlation, the smaller the U and the closer the model comes to predicting turning points accurately. If U = 0, the model is completely accurate in its predictions. If there is a negative correlation between the predicted and the actual values, then U is > 1. In that case, the model predicts turning points in the opposite direction of those which occur in the actual data, and, hence, is clearly an unreasonable model.

The Theil inequality coefficients for the market demand equations are presented in Table 6.1, those for export supply equations in 6.2, product demands in 6.4, and CIF import prices in 6.6. The largest are those for the CIF import price equations, followed by the product demands, export supplies, and market demands. However, the Theil inequality coefficients for the CIF import prices and the product demands are very close in size, as are those for the export supplies and market demands. Thus these last two, the market demand and export supply equations, capture the turning points in the historical data with approximately the same accuracy and better than do those for product demands and CIF import prices. They all do quite well, however. All of the coefficients are considerably less than one.

The rest of the chapter discusses the parameter estimates. Each type of relationship, market demands, export supplies, product demands, and CIF import prices, will be discussed separately with regards to the signs and magnitudes of their parameters. It should be noted that the use of nonlinear 2SLS implies that the parameter estimates are consistent, but biased for small samples. Also, in small samples minimum variance cannot be guaranteed. Therefore, t statistics calculated from the parameter estimates are not totally accurate, and they are not absolutely valid for statistical tests. However, they can give some indication as to the statistical significance of the estimated parameters. The general guidelines followed in this dissertation are that, if a t statistic is greater than one, the parameter is probably significant. If a t value is very small, for example less than .60, the parameter is probably insignificant.

Market Demands

Introduction

Market demands measure the total demands for fresh vegetables in the individual regions. These are filled by the different products, with the individual product shares determined by the product's price relative to the average price of vegetables in the individual regions. Market demands are functions of the average market price of

vegetables in the region, regional income, and regional population.

From Table 6.1 it is clear that, as a group, these variables explain a great deal of the variation in market demands. The R square statistics for the U.S., Canada, the Far East, and Africa are quite high, .871, .790, and .993, respectively. That for Latin America is reasonable at .635. The Non-E.E.C. Western European region has a very low R square, .257. Those for the E.E.C. and the Middle East are negative, which, while theoretically impossible, is a result of the highly nonlinear and restrictive nature of the model. While again it is important to realize the R square statistics in this model can only be used to give general insight into the performance of the model, it is encouraging that four of the eight regions show R square statistics close to one.

The percentage root mean square errors and the Theil inequality coefficients also seem to indicate that the market demand equations do a good job of explaining the variability in this variable. All of the percentage root mean square errors are less than one, with the exception of that for the Middle East which is 3.4. The Theil coefficients are very small, with the largest being that for the Middle East at .016710.

Thus the statistics regarding model performance indicate that the market demand equations are a good fit for the data and simulate the data and capture its turning

points quite well. The following discussion will present a more detailed analysis of the market demand parameters for all regions.

Price elasticities

Economic theory states that the average price of vegetables in a region should negatively effect the quantity of vegetables demanded. The empirical results of the 2SLS estimation of the world trade model indicate that this is the case in Latin America, the United States, the E.E.C., the Middle East, and the Non-E.E.C. Western European region (see Table 6.7). The market demand equations for each of these regions have negative price parameters with t statistics the absolute value of which is greater than one. The one exception is the Middle East which has a t value of -.66. The other regions, Canada, the Far East, and Africa have positive price parameters with only the t value for the Far East being greater than one. Given the limited interpretation it is possible to give t statistics in this model, it is quite possible that price does not affect the level of market demand in these three regions.

Looking more closely at the negative price parameters, they range from very inelastic, -.113, to very elastic, -1.781. These two elasticities correspond to the Non-E.E.C. Western European region's price response and that of the Middle East. Between these two extremes, Latin America and

TABLE 6.7

MARKET DEMAND PARAMETERS AND t-STATISTICS FOR ALL REGIONS.

		$\delta(io)$	$\delta(i1)$	$\delta(i2)$	$\delta(i3)$
i = 1	Latin America	17.019 (9.68)	-0.455 (-1.58)	0.430 (2.15)	-0.234 (-.65)
i = 2	U.S.	15.144 (1.76)	-0.431 (-1.04)	0.642 (.85)	-0.528 (-.20)
i = 3	Canada	3.179 (1.15)	0.117 (.71)	-1.115 (-2.08)	5.552 (3.27)
i = 4	E.E.C.	14.205 (5.16)	-0.722 (-1.64)	0.153 (.78)	0.272 (.86)
i = 5	Middle East	48.222 (.55)	-1.781 (-.66)	3.119 (.55)	-9.48 (-.41)
i = 6	Far East	14.506 (5.28)	0.204 (1.89)	-0.023 (-.21)	0.800 (1.68)
i = 7	Africa	12.475 (22.15)	0.011 (.43)	-0.033 (-.39)	1.009 (6.87)
i = 8	Non-E.E.C. W. Europe	11.417 (4.55)	-0.113 (-1.06)	0.045 (.51)	1.027 (2.45)

$$\text{Log } X(i.) = \log \delta(io) + \delta(i1) \log P(i.) + \delta(i2) \log GDP(i) + \delta(i3) \log POP(i.)$$

Degrees of freedom for each of these equations is 17.

the United States also have quite inelastic responses at -.431 and -.455. The E.E.C. has a moderately inelastic response of -.722. A change in the average market price of vegetables in the Middle East would cause a large response in market demand. The same change in price would cause a much smaller quantity change in all the other regions, with the largest occurring in the E.E.C. and the least in the Non-E.E.C. Western European region. The U.S. and Latin America would each experience a quantity change of less than half any change in price.

Income elasticities

Economic theory postulates that, for normal goods, as income rises, demand rises. However, empirical results for the vegetable trade system indicate that income has little affect on market demands for vegetables in most regions. The parameters associated with income are measured with low levels of significance for all regions except Latin America and Canada (see Table 6.7). Of these two, only Latin America has a positive income elasticity. The other regions with positive income elasticities are the United States, the E.E.C., the Middle East, and the Non-E.E.C. Western European region. The t statistics for each of these are less than one, indicating that they are measured with relatively low levels of confidence.

The most elastic of the positive income parameters is that for the Middle East at 3.119. The most inelastic is that for the Non-E.E.C. Western European region at .045. This is followed by that for the E.E.C. at .153, Latin America at .430, and the U.S. at .642. Thus all of the regions with positive income parameters show inelastic relationships with market demand except the Middle East. The only positive income elasticity with a large t value is that for Latin America. Given the limited interpretation of t statistics in this model, it appears likely that income has very little effect on market demand in the U.S., the E.E.C., the Middle East, and the Non-E.E.C. Western European region.

Canada, the Far East, and Africa have negative income parameters. The very small t values for the Far East and Africa are, again, indications that income has little effect on market demand. The t statistics for Canada is greater than two which, even given the limited interpretation possible with this model, indicates a high level of significance for this parameter. These results indicate that as income rises in Canada, the demand for fresh vegetables drops, implying that fresh vegetables are an inferior good in Canada.

It is possible that the negative income parameter for Canada is incorrect, that in this case the model is not performing as well as it should. Given the size and

complexity of the trade system, it is not possible to make adjustments to deal with this unexpected parameter result. It is also quite possible, since this is a simultaneous system, that if reduced forms were calculated, Canada's income response would be positive.

Population elasticities

As the population of a region rises, thus necessitating that more people be fed, it is generally assumed that the demand for agricultural commodities will rise. Empirical results indicate that to be the case in Canada, the Far East, Africa, the E.E.C., and the Non-E.E.C. Western European region (see Table 6.7). These regions have positive population parameters. The t values for these parameters are all greater than one except that for the E.E.C. which, at .860, is very close to one. Even given the limited interpretation of t statistics possible with this model, the t values for these regions are large enough to indicate a clear positive effect of population on market demand.

Of these positive responses, the most elastic is that for Canada at 5.552. This is distantly followed by the Non-E.E.C. Western European region and Africa at 1.027 and 1.009, respectively. The Far East, at .800, has an inelastic response to population and the E.E.C., at .272, is the most inelastic of the regions with positive responses to market demand.

Latin America, the United States, and the Middle East all have negative population parameters. That for the Middle East is very elastic, -9.481, while those for the U.S. and Canada are inelastic at -.528 and -.234, respectively. The t values for each of these parameters, however, are very small. For the Middle East it is -.41, for the U.S. and Latin America, -.20 and -.65. The low values of these t statistics seem to indicate that population does not affect market demand in the Middle East, the U.S., and Latin America.

Summary of the market demand parameter results

The market demand functions as specified in this study capture a significant amount of the variation in aggregate vegetable demands for all regions. Table 6.1 details the statistics indicating model performance for market demands for all regions. The R square statistics for Latin America, the U.S., Canada, the Far East, and Africa are all fairly large. That for the Non-E.E.C. Western European region is quite small and those for the E.E.C. and the Middle East are negative. These three statistics serve as reminders that, due to the simultaneity, nonlinearity, and complexity of the model, the R square statistics are not completely valid. They can, however, give some indications of model performance. The percentage root mean square errors are all quite small, less than one for all regions except the Middle East. The Theil inequality coefficients are also very

small. These statistics, the percentage root mean square errors and the Theil inequality coefficients, indicate that the model does a good job of simulating and capturing the turning points in the historical data series.

Table 6.7 presents the market demand parameters and t statistics for all eight regions. Following the general guidelines used in this dissertation regarding the size of t statistics and the statistical significance of the parameters, the market demands for Latin America, the U.S., the E.E.C., and the Non-E.E.C. Western European region have negative price responses. The Middle East, with a lower t statistic, may have a negative price response but the evidence is weaker. All of these negative price responses are inelastic with the exception of the Middle East, which is quite elastic.

Regarding market demand responses to GDP, only two regions have income parameters with t statistics greater than one. These are Latin America and Canada. Latin America has a positive and Canada a negative response. These results indicate that either there are problems with the model or data, or that fresh vegetables are an inferior good in Canada. Other regions with positive responses to income are the U.S., the E.E.C., the Middle East, and the Non-E.E.C. Western European region. While their t statistics are less than one, they are not so small as to be able to definitively reject the parameter results. However,

for the Far East and Africa, both with negative income parameters, their t statistics are so small as to indicate that these results are not statistically significant. It is probable that income does not affect market demand in the Far East and Africa. All regions show inelastic income responses with the exceptions of Canada and the Middle East.

Canada, the E.E.C., the Far East, Africa, and the Non-E.E.C. Western European region show positive responses of market demand to population levels. Their t statistics are all quite large. Canada, the Non-E.E.C. Western European region, and Africa have elastic population responses, the Far East inelastic at .800, and the E.E.C. very inelastic at .272. Latin America, the U.S., and the Middle East show negative population responses with t statistics all less than one. It is questionable as to whether population has any effect on market demand in these regions.

Product Demands

Introduction

Product demands are specified as functions of the relative price of the product with respect to the average price of vegetables in the region, and the size of the market for vegetables, or the regional market demand. In essence, markets are composed of products, whose share of the market depend upon their relative prices. Economic theory postulates a negative relationship between this price

ratio and the strength of the demand for the product. Also, theoretically one would expect a positive relationship between product demand and market size. That is, all other things remaining equal, one would expect product demands to increase as market size increased.

Statistics indicating the performance of the product demand equations specified in this model are in Tables 6.3 and 6.5. The R square statistics range from very low, .002 for the Far East's demand for Latin American vegetables, to fairly high, .852 for Africa's demand for Latin American vegetables. This indicates that the functional specification of product demands in this model is more appropriate for some product flows than for others. In general, the R square values for the major trade flows are closer to one than those for which the quantities involved are quite small. As with the market demands, some of the R squares for product demands are negative. While this is theoretically impossible, it occurs due to the highly nonlinear, restrictive nature of the model.

The percentage root mean square errors and Theil inequality coefficients for the product demands are detailed in Table 6.4. In general, they are both larger for the product demands than for the market demands. These results are statistical evidence of a trend seen earlier in the graphs; the market demands both simulate and capture the turning points in historical data better than do the product

demands. Thus the R square statistics, the percentage root mean square errors, the Theil inequality coefficients, and the graphs all indicate that the model's performance is better for the market demands than it is for the product demands. Nevertheless, the fit of the product demands to the data is close enough, as indicated by all of the above types of evidence, to yield insights into the nature and strengths of the relationships driving demand for fresh vegetable products worldwide.

Relative price elasticities

These elasticities measure the percentage change in demand for a product in a region with a change in its market price relative to the average market price of vegetables in the region. Most of these price parameters show a negative relationship between the amount of the product demanded and this price ratio (see Table 6.8).

The exceptions include Latin America's demand for Canadian , European Community, and Middle Eastern vegetables, Canada's demand for African vegetables, the E.E.C.'s demand for Canadian and Non-E.E.C. Western European vegetables, the Middle East's demand for Latin American vegetables, the Far East's demand for U.S. vegetables, Africa's demand for Middle Eastern vegetables, and the Non-E.E.C. Western European region's demand for Canadian and E.E.C. vegetables. In each of these cases,

TABLE 6.8

PRODUCT DEMAND PARAMETERS AND t-STATISTICS FOR ALL REGIONS.

Regions		---Partner Regions---							
		Latin America	U.S.	Canada	E.E.C.	Middle East	Far East	Africa	Non-E.E.C. W. Europe
Latin America	A[a]	. (.)	. (.)	1.810 (.90)	0.481 (.47)	0.067 (.03)	-2.242 (-1.27)	-0.989 (-.65)	-1.173 (-1.37)
	B[b]	. (.)	. (.)	1.029 (.28)	2.577 (1.68)	7.127 (1.20)	0 .848 (.38)	1.431 (.75)	2.691 (4.28)
U.S.	A	-0.620 (-1.98)	. (.)	. (.)	-0.086 (-.55)	-1.654 (-2.06)	-1.285 (-2.90)	-0.481 (-.81)	-2.158 (-1.44)
	B	4.131 (8.01)	. (.)	. (.)	-0.098 (-.16)	9.571 (4.83)	3.271 (2.63)	2.279 (2.37)	-0.991 (-.62)
Canada	A	-0.537 (-3.69)	-0.523 (-5.58)	. (.)	. (.)	-0.761 (-.51)	-0.508 (-.56)	1.058 (.67)	-0.573 (-1.10)
	B	0.416 (1.17)	1.162 (9.72)	. (.)	. (.)	7.746 (3.35)	2.079 (2.40)	-3.239 (-1.14)	-1.627 (-1.35)
E.E.C.	A	-0.280 (-.36)	-4.079 (-2.28)	3.823 (1.83)	. (.)	. (.)	-3.921 (-14.98)	-0.400 (-.49)	1.851 (2.53)
	B	-3.240 (-1.57)	0.393 (.16)	.811 (.13)	. (.)	. (.)	-0.838 (-.63)	-0.005 (-.01)	-0.140 (-.11)

TABLE 6.8--continued

Regions		---Partner Regions---							
		Latin America	U.S.	Canada	E.E.C.	Middle East	Far East	Africa	Non-E.E.C. W. Europe
Middle East	A	1.517 (.74)	-1.841 (-1.84)	-0.849 (-.69)	-2.131 (-6.41)	. (.)	. (.)	-2.476 (-1.90)	-2.156 (-3.38)
	B	0.858 (.45)	1.077 (2.75)	1.786 (3.84)	1.808 (8.95)	. (.)	. (.)	0.860 (2.43)	0.739 (4.49)
Far East	A	-0.798 (-.53)	0.955 (.70)	-3.634 (-1.24)	-1.265 (-2.29)	-2.888 (-3.18)	. (.)	. (.)	-0.005 (1.24)
	B	2.135 (.37)	4.716 (3.77)	11.952 (2.42)	3.285 (3.77)	-2.136 (-.58)	. (.)	. (.)	4.742 (1.29)
Africa	A	-1.264 (-.78)	-2.567 (-3.71)	-1.928 (-2.57)	-1.550 (-1.06)	0.472 (.92)	-1.277 (-1.11)	. (.)	. (.)
	B	15.830 (7.43)	3.683 (2.53)	4.961 (2.18)	2.391 (3.61)	7.234 (8.20)	3.142 (1.70)	. (.)	. (.)
Non-E.E.C.	A	. (.)	-5.348 (-1.57)	3.706 (5.23)	2.704 (3.08)	-3.484 (-7.55)	-0.070 (-.16)	-4.773 (-4.12)	. (.)
	B	. (.)	1.529 (.31)	0.353 (.14)	-0.106 (-.16)	3.729 (1.68)	-7.623 (-1.61)	6.293 (1.31)	. (.)

[a]A = Relative price parameter

[b]B = Market size parameter

$\log X(ij) = \log \phi(0ij) + \phi(1ij) \log P(ij) - \phi(1ij) \log P(i.) + \phi(2ij) \log X(i.)$

Degrees of freedom for each of these equations is 18.

with four exceptions, the t statistics for the parameters are less than one. Given the guidelines discussed earlier regarding the t statistics for this model, the statistical validity of these parameters is doubtful. That is, it is unlikely that the parameters are significantly different from zero so that, in fact, price actually has no effect on these product demands.

The exceptions are the E.E.C.'s demand for Canadian and Non-E.E.C. Western European vegetables and the Non-E.E.C. Western European region's demand for Canadian and E.E.C. vegetables. The price parameters in each of these product demands have t statistics larger than one, indicating that they probably are statistically significant. The fact that as price increases, demand increases, could be explained by the desire on the part of the demanding regions for high quality vegetables. Price is generally regarded as an indicator of quality, if it rises quality is assumed to rise, and vice versa. Given the cases in which this occurs, this seems a plausible explanation, even though no empirical evidence is available to definitively make these observations about quality.

It is also possible that this is another case where the model does not perform as well as it should. Again, due to its size and complexity, it is not possible to make adjustments in the model to deal with this problem. Also, given that it is a simultaneous system, if reduced forms

were calculated these price responses could very well be negative, a more theoretically sound result. It is also possible that there are some problems in the data which lead to these unexpected results.

In general the price elasticities of the product demands are such that those for a region's major suppliers are less elastic than those for less important suppliers. This indicates that a change in the price of a product that is a primary component of a region's total demand for vegetables will cause little change in the region's level of demand for that product. Latin America, the U.S., and Canada generally have fairly inelastic price elasticities of product demand for each other's products and more elastic ones for other suppliers' products. The Middle East, Far East, and Africa have fairly elastic elasticities across the board, indicating that if one supplier raises its prices they will simply switch to another. This makes sense given that no one region, with the possible exception of domestic supplies, is a major supplier for either of these regions. The Non-E.E.C. Western European region also showes this characteristic, with the E.E.C. and Far East showing the least elastic price parameters at 2.704 and -.070 respectively. The E.E.C. is a major supplier to this region with its share nearly doubling from 1962 to 1982. The highly inelastic parameter for the Far East is indicative of why the share of the Non-E.E.C. Western European region's demand composed of the Far East's product stayed relatively

constant from 1962 to 1982. The other products' market shares, with more elastic price parameters, are more volatile.

The price elasticities for the E.E.C. show distinct characteristics. It has highly elastic negative responses to U.S. and Far Eastern vegetables, elastic but positive responses to Canadian and Non-E.E.C. Western European vegetables, and highly inelastic negative responses to Latin American and African vegetables. However, these last two parameter estimates both have t statistics considerably less than one. These results indicate a vegetable market in the E.E.C. that is highly differentiated according to product, and that each product has a distinct pattern of competitiveness in this market, the largest vegetable market in the world. The results suggest that the E.E.C. buys Canadian and Non-E.E.C. Western European vegetables for their quality, and that the demands in this region for Latin American and African vegetables are unaffected by their relative prices in the market. Furthermore, small changes in the price of U.S. vegetables to the E.E.C. have large impacts on the E.E.C.'s demand for that product, and the relative price of Far Eastern vegetables versus the average price of vegetables in the E.E.C. was a major factor in the tremendous increase of this product into the E.E.C. from 1962 to 1982.

<u>Market size elasticities</u>

The signs and values of the parameters for market size indicate the direction and magnitude of change in a product's market share in a region with a change in the size of the region's vegetable market. The results show both positive and negative signs, tending to correspond with trends observed in Chapter II (see Table 6.8). If a region was observed to increase the percentage of its market composed of a particular product, the sign on this parameter is generally positive, and vice versa. In general, demands for products are more elastic with regards to those from a region's less important suppliers and less elastic from its major suppliers.

Many of the t values associated with the market size parameters are quite small. This indicates that in several product demands, market size of the demanding region has no affect on the level of product demand. Latin America has three market size parameters with t values less than one. These are for Canadian, Far Eastern, and African vegetables. The sample sizes of Latin American imports of Far Eastern and African vegetables are so small as to render their parameter estimates invalid. However, that for Canadian vegetables is not. The results seem to indicate that the size of the Latin American market for fresh vegetables does not influence its demand for Canadian vegetables. For the U.S., market size is not significant in explaining its

demand for products from either of the two European regions. Price is also not significant for products from the E.E.C. into the U.S. These results may reflect trade agreements between the U.S. and the E.E.C. that could directly or indirectly influence the fresh vegetable trade. These agreements were made to forestall trade wars between the U.S. and the E.E.C. Canadian market size parameters are all highly significant. All market size parameters for the E.E.C. have t statistics less than one except that for Latin America. These results, along with the price parameters, indicate that price, not market size, is the primary factor in determining product demands, or market shares, in the E.E.C. The Middle East has only one insignificant market size parameter, that for Latin American vegetables. The quantities involved in that product demand are so small that the parameter estimate can be disregarded. All the rest are highly significant and positive. As the market for vegetables grows in the Middle East, all regions, with the possible exception of Latin America, will be able to increase their exports to that region. The Far East has two parameters with t values less than one. These correspond to Latin American and Middle Eastern vegetables. Again, the parameter on the demand for Latin American vegetables can be ignored as the sample size is so small. For all the other regions, the Far Eastern demand for their products increases as the size of the market increases. African market size

parameters are highly significant, elastic, and positive for all products. All regions can increase their exports to Africa as the size of that market increases. The Non-E.E.C. Western European region has market size parameters with t statistics less than one for the U.S., Canada, and the E.E.C. The price parameters on each of these is significant, indicating that price and not market size explain the Non-E.E.C. Western European region's demands for these products.

The market share elasticities for the Latin American, U.S., and Middle Eastern markets show the general trend of being more elastic with regards to products from regions which are not their traditional suppliers and less so for the products which compose the bulk of their imports. Thus as their demands for vegetables grow, these regions are likely to turn to their non-traditional suppliers to fill the added needs. The E.E.C. shows inelastic demands with regards to all products except Latin American vegetables and this parameter has a negative sign. These results indicate that as the E.E.C.'s demand for vegetables grows, it is likely to meet the increased need with domestic supplies. The Non-E.E.C. Western European region is more elastic with vegetables from the Middle East, Far East, and Africa and less so for those from the U.S., Canada, and the E.E.C. This suggests that as the Non-E.E.C. Western European region's vegetable market grows, the Middle Eastern, Far Eastern, and

African shares of that market are likely to grow. Africa and the Far East are quite elastic in their market size parameters with regard to all vegetable products.

Summary of product demand parameter results

To summarize the results for the product demands, most of the price parameters show a negative relationship between price and the amount of the product demanded. The exceptions to this could be a result of regions attempting to purchase high quality products for those parameters which are statistically significant. For those that are not, the data indicate that price is not an important variable in determining those product demands. It is also quite possible that these positive price elasticities are a result of problems with the model or the data. In general, the price elasticities of product demands are more inelastic for a region's major suppliers than for its lesser suppliers. This is also generally true for the elasticities with respect to market size. These inelastic responses to traditional suppliers and relatively elastic responses to products from other sources indicate that the demands for products from established suppliers to a region are likely to remain relatively constant. Changes in price and in the size of the vegetable market in the demanding regions are likely to have little affect on the amounts of these products demanded. However, the demands for products from

regions which are not traditional suppliers to a particular market are likely to be more volatile. Changes in price and the size of the vegetable markets will have major impacts on the quantities of these products demanded. The signs on the parameters for market size are both positive and negative and tend to correspond with the trends observed in Chapter II. If a region was observed to increase the percentage of its market composed of a particular product, the sign on this parameter is generally positive, and vice versa. Thus the elasticities can be regarded as an accurate reflection of reality.

Many of the market size parameters are insignificant, in particular those corresponding to E.E.C. and Non-E.E.C. Western European product demands are statistically insignificant. This indicates that the size of the vegetable market in those regions does not play a significant role in determining product demands. In contrast, almost all of the price parameters for these regions' product demands are significant. Price appears to be the determining factor in E.E.C. and Non-E.E.C. Western European product demands. An important exception to this is the E.E.C.'s demand for African vegetables. In that case, neither of the parameters corresponding to price or market size are statistically significant. Some other factor, not specifically modelled for, explains the E.E.C.'s demand for African vegetables. It will be recalled that in 1962 Africa

made up 61 percent of the E.E.C.'s vegetable imports; by 1982 that had declined to less than 3 percent. The Far East, in contrast, grew from less than 1 percent to more than 78 percent of the E.E.C.'s imports. In this case, price does affect demand; the E.E.C. has a highly elastic price response to Far Eastern vegetables.

Results for the U.S. indicate that market size is probably insignificant in explaining the demand for E.E.C. and Non-E.E.C. Western European vegetables. For E.E.C. vegetables, price is also insignificant. Some factor other than these two explain the U.S.'s imports of fresh vegetables from the E.E.C. Possibly trade agreements made between the U.S. and the Economic Community to forestall trade wars in agricultural commodities are highly explanatory regarding the levels of U.S. imports of E.E.C. vegetables.

The Middle East, Far East, and Africa have been shown to be growth markets. The empirical results indicate that as these markets grow, virtually all exporting regions will be able to increase the quantities they sell to them. The product demands in the Middle East, the Far East, and Africa are very much influenced by market size. In many cases, price is also a significant factor.

CIF Import Prices

Introduction

Looking at the CIF import product prices, from economic theory one would expect a positive relationship between FOB export and CIF import prices and a positive relationship between import prices and year. This later is a trend variable which captures the effect of rising transportation and handling costs. Year is used in the estimation as opposed to the actual costs of transportation and handling in order to minimize data problems. Trend variables are often used in regression analysis involving time series data. One of the reasons is exactly that it is often easier to introduce the trend variable rather than the actual variable, which is closely related to time. In this case, obtaining transportation and handling costs for all the possible trade combinations would be a monumental task. Because these costs are closely related to time and because the major purpose of this study is to obtain a broad view of international vegetable trade and not specifically to focus on how rising transportation costs have affected that trade, the use of the trend variable is justified.

The R square statistics for the CIF import price equations are generally high, indicating that this functional specification does a good job of capturing the variation in the CIF prices (see Table 6.6). The percentage

root mean square errors are quite large, larger than for any of the other three types of equations estimated by the model. These results stem from the small sizes of the CIF prices in the actual data, smaller than market demands, product demands, or export supplies. Slight inaccuracies in the predictive ability of the model will cause large percentage differences between predicted and actual CIF prices, more so than the same level of inaccuracy for market demands, product demands, or export supplies. The Theil inequality coefficients for the CIF price equations are also generally somewhat larger than for any of the others. Thus this functional specification is less accurate in terms of predictive ability and in capturing turning points in the historical data than are those for market demands, product demands, and export supplies. It is possible that this lower level of performance is due to the use of the trend variable year for transportation costs. By construction, the trend variable rises every year but it is not true that transportation and handling costs rose every uear from 1962 to 1982 for every regional trade pattern included in this model. Oil costs did not increase every year, and in the years when they did increase on the world market, the change in transportation costs to individual counries would also be dependent upon the strength of their currencies with respect to the U.S. dollar. Also, the costs of transportation and handling for a particular trade route are

affected by the technology and infrastructure available in the regions involved. For some regions, the facilities may be such that these costs are quite low. For others, these costs may be very high. All of these factors affect the parameter on the trend variable year. Although it was the best option available for this research project, its use weakens the statistical results, particularly with respect to this equation.

Price elasticities

With a few exceptions, CIF import prices are positively related to FOB export prices (see Table 6.9). These exceptions include the U.S.'s CIF price as related to Latin America's FOB price, Canada's as related to Latin America's, the E.E.C.'s as related to the Middle East's FOB price, the Middle East's as related to the Far East's, the Far East's as related to the Middle East, and Africa's CIF price as related to the U.S.'s FOB price. Of these, the only two parameters with t statistics greater than one are the first two. Thus the results indicate that the CIF prices for U.S. and Canadian imported vegetables from Latin America are negatively related to the Latin American FOB price for these vegetables. These are unexpected results and probably reflect either poor performance on the part of the model or data problems. The null hypothesis of no relationship between the CIF import price and the FOB export price can

TABLE 6.9

CIF PRODUCT PRICE PARAMETERS AND t-STATISTICS FOR ALL REGIONS.

Regions		---Partner Regions---							
		Latin America	U.S.	Canada	E.E.C.	Middle East	Far East	Africa	Non-E.E.C. W. Europe
Latin America	A[a]	. (.)	0.690 (1.82)	0.523 (4.07)	0.995 (8.42)	1.099 (2.07)	0.040 (.30)	0.699 (3.51)	0.655 (3.84)
	B[b]	. (.)	13.625 (.26)	117.200 (5.08)	-1.074 (-.05)	-159.760 (-1.25)	155.130 (6.24)	82.507 (2.64)	70.573 (2.44)
U.S.	A	-0.348 (-1.49)	. (.)	0.842 (5.96)	0.921 (13.68)	1.156 (2.02)	2.885 (1.57)	0.597 (3.08)	0.754 (.77)
	B	166.790 (4.05)	. (.)	18.762 (.80)	13.416 (1.64)	82.401 (1.97)	-42.448 (-.38)	23.924 (.96)	12.988 (.13)
Canada	A	-0.372 (-2.30)	0.781 (5.27)	. (.)	0.921 (2.62)	0.381 (1.39)	0.874 (.68)	1.028 (2.38)	1.432 (2.95)
	B	196.890 (5.52)	60.883 (3.15)	. (.)	-45.135 (-1.11)	98.922 (1.82)	52.920 (.47)	15.875 (.17)	-180.140 (-1.63)
E.E.C.	A	1.164 (4.45)	0.558 (2.57)	0.993 (3.26)	. (.)	-0.530 (-.85)	1.241 (9.28)	1.202 (3.93)	1.217 (3.73)
	B	-4.825 (-.12)	65.081 (2.20)	-18.750 (-.24)	. (.)	183.340 (2.56)	-83.852 (-4.49)	12.933 (.30)	-61.637 (-.89)
Middle East	A	1.696 (1.59)	1.775 (1.15)	0.997 (2.72)	1.017 (3.59)	. (.)	-0.363 (-.30)	1.047 (2.34)	0.958 (5.12)
	B	105.730 (.79)	-50.389 (-.23)	3.795 (.06)	-13.740 (-.22)	. (.)	216.620 (1.46)	47.512 (.81)	134.240 (3.49)

TABLE 6.9--continued

Regions		---Partner Regions---							
		Latin America	U.S.	Canada	E.E.C.	Middle East	Far East	Africa	Non-E.E.C. W. Europe
Far East	A	0.567 (2.05)	0.752 (7.95)	0.572 (.68)	1.318 (1.56)	-0.150 (-.33)	. (.)	0.694 (3.58)	0.603 (2.98)
	B	154.520 (2.16)	61.850 (3.79)	13.103 (.09)	-41.259 (-.29)	103.360 (1.95)	. (.)	96.066 (2.12)	17.633 (1.01)
Africa	A	1.360 (1.59)	-0.016 (-.03)	0.145 (.19)	0.737 (6.17)	0.748 (1.52)	0.916 (1.12)	. (.)	1.519 (6.36)
	B	-21.480 (-.22)	97.282 (1.37)	45.411 (1.01)	25.249 (1.14)	-21.911 (-.24)	-10.692 (-.09)	. (.)	-26.356 (-.69)
Non-E.E.C. W. Europe	A	0.237 (2.04)	1.280 (4.99)	0.564 (2.02)	0.990 (35.46)	0.622 (2.79)	1.139 (3.30)	0.006 (7.71)	. (.)
	B	163.520 (6.38)	-18.640 (-.47)	54.142 (2.01)	-7.421 (-1.65)	121.890 (2.72)	72.529 (2.22)	66.791 (3.11)	. (.)

[a]A = FOB price parameter

[b]B = Parameter on year

log C(ij) = log Φ(0ij) + Φ(1ij) log F(ij) + Φ(2ij) log Year

Degrees of freedom for each of these equations is 18.

not be rejected with the small t statistics observed for the Middle East's imports from the Far East, the Far East's and the E.E.C.'s imports from the Middle East, and Africa's imports from the U.S.

All the other price parameters on the CIF price equations are positive. Almost all also have t statistics greater than one. The exceptions are Latin America and Canada's imports from the Far East, the U.S.'s imports from the Non-E.E.C. Western European region, and the Far East and Africa's imports from Canada. Each of these parameters can be disregarded as the quantities involved in these trade patterns are so small that no credence can be attached to the estimates.

In general, for Latin America, the U.S., Canada, the Far East, and the Non-E.E.C. Western European region, the price elasticities are quite low. Most are in the inelastic range, although not all. This implies that a change in the FOB prices of vegetables will not lead to large changes in the CIF prices of vegetables for these regions. In contrast, the E.E.C., Middle East, Far East, and Africa show much more elastic responses to FOB prices.

<u>Elasticities with respect to year</u>

The response of import prices to year is usually positive and quite elastic (see Table 6.9). There are

seventeen parameters which indicate negative elasticities with respect to year, thirteen of which have t statistics less than one. The null hypothesis that CIF prices are not related to year and the transportation costs captured by them cannot be rejected with these low t statistics. There are some CIF prices whose elasticities with respect to year are negative and which have t statistics greater than one. These include Latin America's as related to the Middle East, Canada's as related to the Non-E.E.C. Western European region, the E.E.C.'s as related to the Far East, and the Non-E.E.C. Western European region as related to the E.E.C. The large t statistics indicate that these parameters are statistically significant. It is possible that improvements in technology or the infrastructure for handling the shipping of fresh vegetables between these regions were such that they lowered the costs of this shipping enough to overcome any increases in shipping due to oil price increases.

Several of the parameters associated with year which had positive values were also insignificant. Often, when the parameter for year was insignificant, that for price was highly significant and elastic. For these regions the data reveal that the proxy for transportation costs does not generally explain the variability in the CIF prices of fresh vegetable imports, even with products from the American regions which are shipped quite long distances to arrive at

these markets. The explanatory variable in these cases appears to be the FOB price. Nevertheless, for those CIF price relationships with a statistically significant parameter on the variable year, the positive sign and large value, usually larger than that associated with the FOB price, lead to the conclusion that much of the volatility in fresh vegetable import prices is due to transportation costs.

<u>Summary of CIF import price parameter results</u>

To summarize patterns observed regarding prices from estimation of its relationship to FOB prices and year for Latin America, Canada, the Far East, and the Non-E.E.C. Western European region, much of the volatility in CIF fresh vegetable prices appears to be due to changes in transportation costs. This is indicated by the very elastic and positive response of CIF prices to year. In these regions, changes in the FOB prices of vegetables appear to have little impact on CIF prices; these elasticities are usually inelastic and positive. In contrast, for the U.S., the E.E.C., the Middle East, and Africa, the FOB prices appear to have more of an impact on CIF price changes than do transportation costs. In virtually every CIF relationship estimated, at least one of the parameters was significant as indicated by a t statistic greater than one.

Export Supplies

Introduction

With regards to the export supply relationship, from economic theory one would expect positive responses to both price and production levels. It is basic economic theory that supply has a positive response to price. Also, since export supply is defined as production less domestic demand, if production increases, all else held constant, export supply will increase. Thus in this system, export supply is specified as a function of the regional average export price and the production level. The R square statistics are generally high, indicating that this specification is a good fit for the data (see Table 6.2). The percentage root mean square errors are low, therefore simulations of historical data are very close to the actual values. The Theil inequality coefficients are also low, indicating that this functional specification captures turning points in the data quite well. Overall, the specification of the export supply equations as estimated in this model does a good job of capturing the variability in this endogenous variable, predicting its values, and capturing the turning points in the historical data.

<u>Price elasticities</u>

All of the price elasticities are positive with the exception of those for the Far East and the Non-E.E.C. Western European region (see Table 6.10). Both of these parameters have t statistics greater than one, indicating that they are statistically significant. The negative parameter for the Far East probably reflects the fact that its primary export market is the E.E.C. The CAP of the E.E.C. distorts the workings of the market place to the extent that this result is quite logical. The E.E.C. sets reference prices for which all products exported to the E.E.C. must sell. These prices are usually higher than the world price for comparable products. The Far East receives preferential treatment in that its products may be imported into the E.E.C. at lower than the reference price. Consequently this region has a competitive edge in the E.E.C. vegetable market. Because this was the Far East's primary market from 1962 to 1982, the greater its competitive edge, that is, the lower its average export price, the more vegetables it could sell and the higher the levels of export supply. Its level of response to changes in the average export price is quite high, at -5.420 this is the most elastic price parameter for any region's export supply equations. The negative and statistically significant price elasticity for the the Non-E.E.C. Western European region is unexpected. In this case, the model may

TABLE 6.10

EXPORT SUPPLY PARAMETERS AND t STATISTICS FOR ALL REGIONS.

		$\rho(0j)$	$\rho(1j)$	$\rho(2j)$
i = 1	Latin America	-30.476 (-3.05)	0.427 (3.11)	2.478 (4.50)
i = 2	U.S.	31.663 (1.03)	1.504 (1.63)	-0.901 (-.53)
i = 3	Canada	0.185 (.04)	0.192 (2.18)	0.835 (2.93)
i = 4	E.E.C.	5.407 (.62)	0.156 (2.11)	0.472 (.97)
i = 5	Middle East	3.159 (1.15)	0.015 (.12)	0.567 (3.71)
i = 6	Far East	-590.36 (-1.69)	-5.420 (-1.18)	30.474 (1.74)
i = 7	Africa	52.710 (5.20)	0.243 (1.52)	-2.136 (-3.93)
i = 8	Non-E.E.C. W. Europe	11.417 (.43)	-0.123 (8.88)	0.045 (1.28)

$$\log [X(.j) - X(jj)] = \log \rho(0j) + \rho(1j) \log F(.j) + \rho(2j) \log X(ij)$$

Degrees of freedom for each of these equations is 18.

not be working as well as it should. However, given the size and complexity of the model, it is not feasible to adjust it in order to obtain a more realistic result.

All of the export supply price elasticities are inelastic with the exception of those for the Far East and the U.S. At 1.504, the U.S. has the second most elastic response to price with regards to its export supply. All of these parameters have t values greater than one with the exception of that for the Middle East. For this region the null hypothesis that export supplies are unaffected by the levels of their average export price cannot be rejected; its t value is much too small to indicate that this parameter is statistically significant.

Production elasticities

All of the production elasticities are positive with the exception of those of the United States and Africa (see Table 6.10). These negative parameter estimates probably reflect the fact that, although the levels of production in these regions rose, the share of world exports composed of U.S. and African vegetables dropped from 1962 to 1982. Although production levels rose in these regions, the proportion of their total production exported fell. Of these parameters, that for Africa is greater than one while that for the U.S., with a t value of -.53, is quite small. Therefore the null hypothesis that export supply from the

U.S. is not affected by the level of production cannot be rejected.

The most elastic production elasticity is that for the Far East at 30.474. This is quite logical given the phenomenal growth in the demand for this region's product. Essentially the data seem to indicate that the Far East could export as much as it could produce. Latin America and Africa are the next most elastic regions; at approximately 2.00, they each have elastic responses in terms of export supply to production levels. All other regions have inelastic responses. All also have t values greater than one, except the E.E.C. which has a t value of .97.

Summary of export supply parameter results

The functional specification for the export supply equations is highly appropriate for this endogenous variable as indicated by the R square statistics, the percentage mean square errors, and the Theil inequality coefficients. The individual variables, price and production, are also generally statistically significant in explaining variation in this variable, as the high t values indicate. These conclusions are, of course, subject to the limitations of the model in terms of the validity of the R square and t statistics. In general, export supplies have a positive and inelastic relationship with price. The response to production is also generally positive, with about half of

the regions responding in an elastic manner and about half in an inelastic manner. These largely inelastic responses, coupled with the lower levels of growth of export supplies as compared to imports, are further evidence that the growth in international trade in vegetables is driven by an increase in the strength of demand and not by changes in the availability of supplies (see Tables 2.2 and 2.3).

Conclusion

The simultaneous world trade system for vegetables has been estimated and the results discussed in this chapter. In general these results make economic sense and yield insights into the trends observed in Chapter II. For almost every functional relationship in the model, market demands, product demands, CIF import prices, and export supplies, every region is responsive to at least one of the explanatory variables. These explanatory variables were chosen with care on the basis of economic theory. Interferences in the workings of the market place exist, such as preferential treatments of some regions by others, tariff and non-tariff barriers, export subsidies, and trade agreements. The impacts of these institutionally imposed interferences with the market can be discerned in the econometric results and have been noted in this chapter.

Chapter VII will focus on the insights and implications of the estimation results for the patterns of world trade in

fresh vegetables. Each region will be discussed in terms of the implications of the results for its trading patterns, with particular attention given to the Far East, the E.E.C., and the U.S. These three regions dominated fresh vegetable trade from 1962 to 1982. This discussion will allow for a more complete understanding of how each individual region relates to the other regions and to the world trade system in fresh vegetables as a whole.

The parameters estimated for the world vegetable trade system will be used to simulate the effects of changes in the major variables which affect international trade in fresh vegetables. These include market prices, population levels, regional incomes, production levels, and the regional average export prices. Chapter VIII will discuss the exact simulations carried out and their results. Policy implications of these simulations will also be discussed.

The final chapter will review the entire study and discuss its implications and relevance to policy makers and traders of fresh vegetables, particularly from a U.S. point of view.

CHAPTER VII

RELATION OF ESTIMATION RESULTS TO WORLD TRADE PATTERNS

Introduction

Chapter VI presented and discussed the econometric results and overall performance of the trade model. The predictive ability of the model, as well as the relative fit of the equations were discussed. The estimated parameters were considered for each type of equation with respect to their signs, magnitudes, and statistical significance. When possible, the parameter estimates were related back to the patterns of world trade as revealed in Chapter II. However, the main focus was the results themselves and their theoretical consistency.

Chapter VII will concentrate on the insights and implications of the results to the world trade system in fresh vegetables. Each region will be reviewed separately as to the within region results and to those of other regions' equations which relate to it. The insights and implications of these parameter estimates will be discussed from the point of view of each region as an exporter, an importer, and its relations to the other regions of the world in terms of vegetable trade. The Far East, the

E.E.C., and the U.S., which, combined, dominated world vegetable trade from 1962 to 1982, will be covered last. In this way it will be easier to relate the results of the other regions to those of these three dominate regions.

Estimation Results with Respect to Latin America

Although Latin America is actively involved in international trade of fresh vegetables, the levels of growth of its exports and imports from 1962 to 1982 were well below those of most of the other seven regions included in this study (see Tables 2.2 and 2.3). Nevertheless, its trade with the U.S. and Canada is significant and it receives a fair proportion of its imports from the E.E.C. and the Non-E.E.C. Western European region. Also, Latin American exports to the growth regions of the Middle East and Africa increased from 1962 to 1982 (see Tables C.1, C.2, C.8, and C.14). These interactions need to be examined as to what economic forces are at work and whether they will likely work to increase or decrease Latin American participation in fresh vegetable trade in the future.

Latin American Exports

From 1962 to 1982 the absolute quantity of Latin American exports fell by 20 percent (see Table 2.3). This was not due to a decline in production as its 1982 level of production was 1.5 times that of 1962. Its export supply parameters indicate positive regional responses to the

average export price and production (see Table 6.10). Consequently this decline must be due to a fall in the strength of demand for Latin American vegetables from other regions or an increase in the strength of domestic demand. Also, it is possible that some estimation, modeling, and/or data problems could influence the results.

The major markets for Latin American vegetables are the U.S., Canada, the E.E.C., and the Non-E.E.C. Western European region. From 1962 to 1982 the U.S. and Canada declined in importance to Latin America while the E.E.C. increased and the Non-E.E.C. Western European region retained the same share of Latin American exports (see Tables C.8 and C.14). U.S. and Canadian product demand parameters for Latin American vegetables are statistically significant for both price and market share (see Table 7.1). The price elasticities for the U.S. and Canada are negative and inelastic. The market size parameter on the U.S. product demand is positive and very elastic, Canada's is positive and inelastic. It is possible that U.S. and Canadian demands for Latin American vegetables declined due to price increases. The E.E.C.'s market size parameter for Latin American vegetables is negative and very elastic. Its price parameter is insignificant. Some factors that are not specifically modelled for in the product demand equation must be contributing to the strength of the E.E.C. demand for Latin American vegetables. The Non-E.E.C. Western European region's product demands for Latin American

TABLE 7.1

PRODUCT DEMAND PARAMETERS AND t STATISTICS OF ALL REGIONS FOR LATIN AMERICAN FRESH VEGETABLES.

	$\phi(0il)$	$\phi(1il)$	$\phi(2il)$
Latin America	.	.	.
	(.)	(.)	(.)
U.S.	-58.717	-0.620	4.131
	(-657.00)	(-1.98)	(8.01)
Canada	4.487	-0.537	0.416
	(.82)	(-3.69)	(1.17)
E.E.C.	70.262	-0.280	-3.240
	(1.88)	(-.36)	(-1.51)
Middle East	-9.705	1.517	0.858
	(-.32)	(.74)	(.45)
Far East	-33.804	-0.798	2.135
	(-.30)	(-.53)	(.37)
Africa	-279.800	-1.264	15.830
	(-7.03)	(-.78)	(7.43)
Non-E.E.C. W. Europe	.	.	.
	(.)	(.)	(.)

$$\log X(il) = \log \phi(oil) + \phi(1il) \log P(il) - \phi(1il) P(i.) + \phi(2il) \log X(i.)$$

Degrees of freedom for each of these equations is 18.

vegetables were not estimated, therefore little can be said about this trade pattern. It is, however, clear that some factor contributes to a strong level of demand for this product in the Non-E.E.C. Western European region because, although the Non-E.E.C. Western European region lost members to the E.E.C. from 1962 to 1982, its level of demand for Latin American vegetables was maintained.

Latin American exports to the Middle East increased from 1962 to 1982 (see Tables C.8 and C.14). The Middle Eastern product demand and CIF product price equations indicate that this increase could possibly have been due to the price effect (see Tables 7.1 and 7.2). The price parameter on the product demand equation is positive and, while its t value is less than one, it is still fairly large. These results indicate that as the price of Latin American vegetables increases in the Middle Eastern market, the demand for this product increases. The CIF product price equation indicates that both the FOB price and the transportation and handling costs affect the CIF price in a positive and statistically significant manner (see Table 7.2). Thus as the FOB price and transportation costs of Latin American vegetables to the Middle Eastern market increase, the CIF price of this product increases. This, in turn, increases the market price of this product, which according to empirical results, affects the demand in a positive manner.

TABLE 7.2

CIF PRODUCT PRICE PARAMETERS AND t STATISTICS OF ALL REGIONS FOR LATIN AMERICAN FRESH VEGETABLES.

	$\Phi(0il)$	$\Phi(1il)$	$\Phi(2il)$
Latin America	.	.	.
	(.)	(.)	(.)
U.S.	-1267.390	-.348	166.790
	(-4.05)	(-1.49)	(4.05)
Canada	-1495.700	-0.372	196.890
	(-5.52)	(-2.30)	(5.52)
E.E.C.	37.021	1.164	-4.825
	(.12)	(4.45)	(-.12)
Middle East	-801.000	1.696	105.730
	(-.79)	(1.59)	(.79)
Far East	-1172.570	0.567	154.520
	(-2.16)	(2.05)	(2.16)
Africa	163.790	1.360	-21.480
	(.22)	(1.59)	(-.22)
Non-E.E.C. W. Europe	-1241.330	0.231	163.520
	(-6.38)	(2.04)	(6.38)

$$\log C(il) = \log \Phi(0il) + \Phi(1il) \log F(il) + \Phi(2il) \log Year$$

Degrees of freedom for each of these equations is 18.

There are several possible explanations for this positive price parameter, which is a theoretically inconsistent result. In no way is it possible that the demand function is actually upward sloping, as a positive price parameter would indicate. The empirical model was estimated relating consumption to price and other variables, using annual data. Over these years, it is conceivable that quality or product characteristics improved. If such improved quality products also command higher prices, then the measured prices entering the model would also reflect quality changes. If this situation were true, then the price parameter could yield positive values simply because it is measuring the confound effects of both the true price as well as quality differences. Unfortunately, the data set does not allow one to measure the potential quality differences over time. It is also possible that this result is simply wrong, that the model is not performing well. Another explanation could be that there are data problems which would lead to this, an inconsistent result.

The market size parameter on the Middle Eastern product demand for Latin American vegetables is statistically insignificant. As the Middle Eastern market for fresh vegetables grows, its demand for Latin American vegetables will be unaffected.

Latin American exports to Africa also increased from 1962 to 1982 (see Tables C.8 and C.14). The African product

demand equation indicates that both the market price of Latin American vegetables and the size of the African market affect its demand for this product (see Table 7.1). The price parameter is negative and elastic, indicating a normal good, and the market size parameter is positive and very elastic. The CIF price parameters indicate that, while the parameter on the FOB price of Latin American vegetables is positive, elastic, and statistically significant, indicating that it affects the CIF price, that for transportation and handling costs is statistically insignificant (see Table 7.2). Thus it appears that the primary force leading to increased Latin American exports to Africa is the growth in the African market demand for fresh vegetables. This is a strong force as the African demand for imports of fresh vegetables increased more than four fold from 1962 to 1982 (see Table 2.2).

Latin American exports to the Far East did not increase. In fact, the quantities involved in this trade from 1962 to 1982 were so small as to make any parameter estimates suspect. It is not possible to draw definitive conclusions from the empirical results, nevertheless the results do lend some insights. The parameters on the Far East's product demand for Latin American vegetables are all statistically insignificant, those on the CIF price equation are significant (see Tables 7.1 and 7.2). The FOB price of Latin American vegetables affects its CIF price to the Far

East in a positive, but inelastic manner. The transportation costs affect the CIF price in a very elastic, positive manner. However, since the price parameter on the Far East's product demand equation is insignificant, these relationships apparently have little to no effect on the Far East's demand for Latin American vegetables. None of the factors modelled for, including price and market size, seem to give Latin American vegetables a competitive advantage in the Far Eastern market. There is virtually no demand for this product in the Far East and nothing in the empirical results indicates any change in this pattern.

Latin American Imports

Latin American imports of fresh vegetables essentially maintained their status quo from 1962 to 1982; its level of growth was 1.1 (see Table 2.2). The market demand parameters indicate that this region is responsive to price and income in a negative and positive way, respectively. Both of these responses, however, are inelastic. Population, apparently, does not affect the demand for vegetables in Latin America; this parameter is statistically insignificant (see Table 6.7).

Most of Latin America's imports are from the U.S., Canada, the E.E.C., and the Non-E.E.C. Western European region. It receives virtually no imports from the Middle East, Far East, or Africa. From 1962 to 1982 the U.S. and

the Non-E.E.C. Western European region increased in importance as suppliers, while Canada and the E.E.C. decreased (see Tables C.1 and C.7). Latin American product demand parameters and CIF price parameters give some insights as to the reasons for these changes.

Latin American product demand parameters for the Non-E.E.C. Western European region indicate elastic responses to both price and market size, with the price response negative and the market size response positive (see Table 6.8). Its CIF price parameters indicate that the CIF price of the Non-E.E.C. Western European region's vegetables to Latin America are affected in a positive manner by both the FOB price and the proxy for transportation costs (see Table 6.9). The FOB price response is inelastic while that for transportation costs is elastic. Latin American demand parameters for E.E.C. and Canadian vegetables indicate statistically significant responses to only the market size in the case of the E.E.C., and the market price in the case of Canada. Both of these responses are positive and elastic.

The positive response to Canadian vegetables, while not definitive proof, could be evidence that Canadian vegetables are seen as a lower quality product than those of other regions in Latin America. When its price increases, indicating that its quality has increased, demand for this product increases. This is not to say that the demand

function has a positive slope. The positive price parameter could indicate that demand shifted to the right from 1962 to 1982. The data, with only twenty-one observations, is not dense enough to reveal two demand functions, it only allows the model to discern that price and quantity both increased and therefore conclude that a positive relationship exists between them. It is also possible that there are model or data problems leading to this unexpected result.

The CIF price to Latin America of Canadian vegetables is positively affected by both the FOB price and transportation costs. The first in an inelastic manner and the second in a very elastic manner. Increases in the FOB price and the transportation costs of Canadian vegetables to Latin America will increase its CIF price, market price, and if the positive price elasticity is correct, will increase Latin American demand for Canadian vegetables.

All of these results seem to indicate that the Non-E.E.C. Western European region was able to expand its exports to Latin America because of the highly elastic market size parameter on Latin America's demand for this product. While Latin America also has an elastic market size parameter for E.E.C. vegetables, it is less elastic than that for the Non-E.E.C. Western European region. Also, while Latin America has an elastic price response to Canadian vegetables, it is less so than the market size response to Non-E.E.C. Western European vegetables. These

differences apparently more than account for the negative price effect with regard to the Non-E.E.C. Western European region.

Implications for World Vegetable Trade

Results of this study indicate that, although the levels of growth of Latin America's exports and imports were low relative to the other regions from 1962 to 1982, this region is a strong participant in international trade of fresh vegetables. Its exports to the E.E.C., the Middle East, and Africa, three of the strongest import growth markets, increased. Exports to the U.S. and Canada decreased, while the status quo was maintained with the Non-E.E.C. Western European region (see Tables C.8 and C.14). These results point to the conclusion that Latin America's pattern of exports of fresh vegetables is changing. It is breaking out of its established markets of the U.S. and Canada and building strength in other import markets. As these markets grow or Latin America increases the competitiveness of its product on the world market, Latin American exports of fresh vegetables, particularly to the growth regions of the E.E.C., the Middle East, and Africa should increase.

On the import side, some change is also occurring in Latin America's pattern of participation. It still relies on its traditional suppliers of the U.S., Canada, the E.E.C., and the Non-E.E.C. Western European region for its

imports, but the shares from the U.S. and the Non-E.E.C. Western European region are increasing while those from Canada and the E.E.C. are decreasing (see Tables C.1 and C.7). In the case of the Non-E.E.C. Western European region, this is probably due to the very elastic market size response. Responses to either price or market size on Canadian and E.E.C. vegetables are not as large as that for the Non-E.E.C. Western European region on market size, which probably accounts for their decreased shares of the Latin American import market.

Estimation Results with Respect to Canada

Canada is a strong participant in international vegetable trade. While its growth in imports from 1962 to 1982 was not substantial, it showed the second highest growth rate in exports (see Table 2.3). As an importer it trades almost exclusively with the U.S. and Latin America. As an exporter its markets include all seven of the other regions included in this study. In Latin America, the E.E.C., and the Non-E.E.C. Western European region, empirical results indicate a positive relationship between price and quantity. This almost certainly is not a signal that the demand function is upward sloping, but more likely reflects problems with the model or data.

Canadian Exports

From 1962 to 1982 Canadian exports of fresh vegetables increased by 2.71 times (see Table 2.3). This was the second highest growth of exports among the eight regions. The export supply equation indicates significant but inelastic responses to both the average export price for Canadian vegetables and its level of production (see Table 6.10).

Canadian trade partners and their import shares of Canadian vegetables changed very little from 1962 to 1982 (see Tables C.8 and C.14). In 1962 the U.S. received 40 percent of Canadian exports; Latin America 26 percent; the E.E.C. 19 percent; and the Non-E.E.C. Western European region, 15 percent. In 1982 the U.S. received 51 percent; Latin America 24 percent; the E.E.C. 14 percent; and the Non-E.E.C. Western European region, 4 percent. The product demand equations for these regions indicate that Latin America, the E.E.C., and the Non-E.E.C. Western European regions are affected in positive and elastic manners by the price of this product (see Table 7.3). Their demands for Canadian vegetables are not affected by the size of their market demands for fresh vegetables. Because the market size parameters for each of these regions is statistically insignificant, it appears that, in these cases, price is the primary force driving the demand for this product and hence, the primary driving force in the increase in Canadian

TABLE 7.3

PRODUCT DEMAND PARAMETERS AND t STATISTICS OF ALL REGIONS FOR CANADIAN FRESH VEGETABLES.

	$\phi(0i3)$	$\phi(1i3)$	$\phi(2i3)$
Latin America	-7.394	1.810	1.029
	(-.11)	(.90)	(.28)
U.S.	.	.	.
	(.)	(.)	(.)
Canada	.	.	.
	(.)	(.)	(.)
E.E.C.	-5.653	3.823	0.811
	(-.05)	(1.83)	(.13)
Middle East	-23.621	-0.849	1.786
	(-2.91)	(-.69)	(3.84)
Far East	-226.460	-3.634	11.952
	(-2.33)	(-1.24)	(2.42)
Africa	-82.282	-1.928	4.961
	(-1.99)	(-2.57)	(2.18)
Non-E.E.C.	4.671	3.706	0.353
W. Europe	(.11)	(5.23)	(.14)

$$\log X(i3) = \log \phi(0i3) + \phi(1i3) \log P(i3) - \phi(1i3) \log P(i.) + \phi(2i3) \log X(i.)$$

Degrees of freedom for each of these equations is 18.

exports. The positive sign on these price parameters is, however, theoretically inconsistent. It is unlikely that these product demand functions have a positive relationship between price and quantity. A possible explanation for these results is that from 1962 to 1982 the demand functions shifted to the right. Due to the small data set, this shift is not evident. What is apparent is that both price and quantity increased. This then leads to the result which seems to indicate a positive relationship between the two. It is also possible that these results are incorrect, that the model is not performing as well as it should. There could also be data problems, besides those mentioned above, which lead to these results.

Canada's exports to the Middle East, the Far East, and Africa increased from 1962 to 1982. While these markets received very small shares of Canada's exports, in 1982, .94, 2.31, and 3.16 percent, they are growth markets and therefore this growth needs to be investigated (see Tables C.1 and C.7). The parameters on market size for each of these regions corresponding to Canadian vegetables is positive, elastic, and statistically significant. The price parameters are negative. That for the Middle East is inelastic and insignificant. Those for the Far East and Africa are elastic and highly significant. Together these parameter estimates indicate that as the markets for fresh vegetables grow in the Middle East, Far East, and Africa, it

can be expected that their demands for Canadian vegetables will increase.

The regional CIF product price equations indicate that the CIF price of Canadian vegetables has a positive but inelastic relationship with its FOB price in all regions except the Far East and Africa. The t statistics for these two regions are so small that the null hypothesis of no effect cannot be rejected for the FOB prices of these regions (see Table 7.4). There is a positive and highly elastic relationship between the CIF price and transport and handling costs in all regions except the U.S., the E.E.C., the Middle East, and the Far East. These four regions have such small t values that they cannot be considered statistically significant.

Canadian Imports

Canadian imports of fresh vegetables grew by 1.46 times from 1962 to 1982 (see Table 2.2). Its market demand parameters indicate a positive, although inelastic, response to price, a negative, elastic response to income, and a positive, elastic population response (see Table 6.7). The positive price elasticity is associated with a small t statistic and is most likely statistically insignificant.

Canada's major supplier is the U.S., with Latin America filling virtually all of the remaining import market (see Table C.8). The product demand parameters on these indicate

TABLE 7.4

CIF PRODUCT PRICE PARAMETERS AND t STATISTICS OF ALL REGIONS FOR CANADIAN FRESH VEGETABLES.

	$\Phi(0i3)$	$\Phi(1i3)$	$\Phi(2i3)$
Latin America	-889.770	0.523	117.200
	(-5.07)	(4.07)	(5.08)
U.S.	-142.780	0.842	18.762
	(-.80)	(5.96)	(.80)
Canada	.	.	.
	(.)	(.)	(.)
E.E.C.	142.450	0.993	-18.750
	(.24)	(3.26)	(-.24)
Middle East	-28.473	0.997	3.795
	(-.06)	(2.72)	(.06)
Far East	-99.690	0.572	13.103
	(-.09)	(.68)	(.09)
Africa	-345.780	0.145	45.411
	(-1.01)	(.19)	(1.01)
Non-E.E.C.	-411.230	0.564	54.142
W. Europe	(-2.01)	(2.02)	(2.01)

$$\log C(i3) = \log \Phi(0i3) + \Phi(1i3) \log F(i3) + \Phi(2i3) \log \text{Year}$$

Degrees of freedom for each of these equations is 18.

that Canada is responsive to both Latin American and U.S. products in a price and market size manner (see Table 6.8). Both price elasticities are negative and inelastic, as well as virtually equal. The market size elasticity on Latin American vegetables is inelastic while that on U.S. vegetables is elastic. This indicates that as the Canadian market for fresh vegetables grows, the percentage supplied by the U.S. will increase and that by Latin America will decrease. This was the pattern observed from 1962 to 1982.

Implications for World Vegetable Trade

Canada is a growth region both in terms of its exports and imports, although its growth in exports far exceeded that in imports. Although it is experiencing growth, this is primarily occurring within previously established patterns of trade. The regions receiving virtually all of its exports are the U.S., Latin America, the E.E.C., and the Non-E.E.C. Western European region. However, Canada did increase its exports to the Middle East, the Far East, and Africa, thus participating in the growth of these regions (see Tables C.8 and C.14). Empirical results indicate that as these markets grow, Canada's exports to the Middle East, the Far East, and Africa will increase. Virtually all of Canada's imports are from the U.S. and Latin America (see Tables C.1 and C.7). Nothing in the empirical results indicates that any other region will gain shares of the Canadian import market in the near future.

Estimation Results with Respect to the Middle East

The Middle East has not traditionally been a major market for or supplier of fresh vegetables. However, from 1962 to 1982 its participation in both of these aspects of vegetable trade grew. Its imports more than tripled and its exports more than doubled. Middle Eastern production of fresh vegetables more than quadrupled (see Table 2.1). Growth of this magnitude in all facets of fresh vegetable trade indicates that the Middle East is a region that merits attention in order to discover any trends occurring in this growth and to discover likely future directions of growth. Knowledge of this sort would be very useful to any region attempting to increase its participation in world vegetable trade, as an importer or exporter.

Middle Eastern Exports

In 1962 the major markets for Middle Eastern vegetables were the Non-E.E.C. Western European region and the E.E.C. They received 86 and 13 percent of Middle Eastern exports, respectively. By 1982 the Middle East had expanded to include the Far East and Africa. In order of importance the Middle Eastern markets were Africa, the E.E.C., the Far East, and the Non-E.E.C. Western European region with approximately 30 percent for both Africa and the E.E.C., 29 percent for the Far East, and 7 percent for the Non-E.E.C.

Western European region (see Tables C.8 and C.14). Latin America, the U.S. and Canada received virtually no share of Middle Eastern exports. The quantities imported into the U.S. and Canada were so small that no merit can be attached to parameters estimated from these samples. Latin America received larger quantities and therefore the parameter estimates are valid.

Exports of fresh vegetables more than doubled and production more than quadrupled for the Middle Eastern region from 1962 to 1982. Estimation results indicate that export supply quantities are unaffected by the average price for Middle Eastern exports but they are affected by production levels (see Table 6.10). Even so, the response of export supplies to production levels is inelastic. Therefore the doubling of its exports indicates that demand for Middle Eastern vegetables grew. Empirical results on regional demands for Middle Eastern vegetables can lend some insight into the forces operating to cause this growth.

Product demand parameters for Africa indicate that as the African market for fresh vegetables grows, its demand for Middle Eastern vegetables will grow (see Table 7.5). This is evidenced by the highly significant and elastic parameter on the market size variable. The price parameter, while significant at the .25 level, is inelastic. The CIF price parameters on African imports of Middle Eastern vegetables indicate that this price is not affected by

TABLE 7.5

PRODUCT DEMAND PARAMETERS AND t STATISTICS OF ALL REGIONS FOR MIDDLE EASTERN FRESH VEGETABLES.

	ϕ(0i5)	ϕ(1i5)	ϕ(2i5)
Latin America	-121.750 (-1.14)	0.067 (.03)	7.127 (1.20)
U.S.	-159.450 (-4.64)	-1.654 (-2.06)	9.571 (4.83)
Canada	-113.410 (-3.23)	-0.761 (-.51)	7.746 (3.35)
E.E.C.	. (.)	. (.)	. (.)
Middle East	. (.)	. (.)	. (.)
Far East	49.839 (.69)	-2.888 (-3.18)	-2.136 (-.58)
Africa	-121.790 (-7.56)	0.412 (.92)	7.234 (8.20)
Non-E.E.C. W. Europe	-52.299 (-1.39)	-3.484 (-7.55)	3.729 (1.68)

$$\log X9i5) = \log \phi(0i5) + \phi(1i5) \log P(i5) - \phi(1i5) \log P(i.) + \phi(2i5) \log X(i.)$$

Degrees of freedom for each of these equations is 18.

transportation costs and has only an inelastic response to changes in the FOB price (see Table 7.6). Thus the majority of the increase in African demand for Middle Eastern vegetables has been and will be driven by the growth of this market for fresh vegetables.

The Far East, on the other hand, shows a statistically significant, elastic price parameter with an insignificant market size parameter. Transportation costs greatly affect the CIF price of this product. The growth in Far Eastern demand for Middle Eastern vegetables is apparently driven by decreases in the price of this product.

The Non-E.E.C. Western European region has statistically significant, elastic price and market size parameters. It also has significant parameters on both variables affecting the CIF price. That on the FOB price is inelastic while that on transportation costs is very elastic. The proportion of Middle Eastern exports going to the Non-E.E.C. Western European region declined from 1962 to 1982 due perhaps to the drop in the membership of that region or to price increases as a result of transportation and distribution cost increases. The change in membership would also be one reason for the increase in the proportion going to the E.E.C.

Results for Latin America indicate that as this region's market for vegetables grows, its demand for Middle Eastern vegetables will grow. The price parameter on its

TABLE 7.6

CIF PRODUCT PRICE PARAMETERS AND t STATISTICS OF ALL REGIONS FOR MIDDLE EASTERN FRESH VEGETABLES.

	$\Phi(0i5)$	$\Phi(1i5)$	$\Phi(2i5)$
Latin America	1213.110 (1.25)	1.099 (2.07)	-159.760 (-1.25)
U.S.	-625.070 (-1.97)	1.156 (2.02)	82.401 (1.97)
Canada	-750.790 (1.82)	0.381 (1.39)	98.922 (1.82)
E.E.C.	-1383.140 (-2.56)	-0.530 (-.85)	183.340 (2.56)
Middle East	. (.)	. (.)	. (.)
Far East	-785.430 (-1.96)	-0.150 (-.33)	103.360 (1.95)
Africa	165.840 (.24)	0.748 (1.52)	-21.911 (-.24)
Non-E.E.C. W. Europe	-925.160 (-2.71)	0.622 (2.79)	121.890 (2.72)

$\log C(i5) = \log \Phi(0i5) + \Phi(1i5) \log F(i5) + \Phi(2i5) \log \text{Year}$

Degrees of freedom for each of these equations is 18.

product demand equation is statistically insignificant. However, Latin America is not a growth region for fresh vegetables, its imports just maintained their status quo from 1962 to 1982. Given that Middle Eastern imports into Latin America grew from 1962 to 1982, even with the lack of growth of the absolute quantity of vegetable imports into Latin America, Middle Eastern vegetables must be highly competitive with other vegetable products, at least in the Latin American market. Empirical results indicate that this competitive advantage does not stem from price; its relative price parameter is statistically insignificant. The theoretical basis of the model used for this study is that each region produces a unique vegetable product; for some reason the Middle Eastern product is gaining a share of the Latin American market. It could be that the mix of vegetable types exported by the Middle East is particularly desirable to Latin Americans. It could also be due to any number of other qualities which are not specifically modelled for in this study such as time of harvesting, shipping arrangements, financial arrangements, and other factors which could render Middle Eastern vegetables highly desirable in the Latin American market. It is important to note that, while this trade flow is showing strong growth, it is still a small portion of world trade in fresh vegetables. Latin American demand for Middle Eastern vegetables is not one of the major trade flows of this commodity, but it does show potential for growth.

Middle Eastern Imports

The Middle East is a growth region for imports and the shares supplied by the various regions are changing. These two characteristics of the Middle Eastern import market make it an important market to understand from the point of view of exporting regions.

The market demand parameters for the Middle East's vegetable market are all statistically insignificant (see Table 6.7). Therefore few, if any, conclusions can be drawn from this equation. Even though they are insignificant, the parameter signs for price and income conform to that suggested by theory, negative for price and positive for income. That for population is negative and highly elastic.

In 1962 the major suppliers of the Middle Eastern import market were the Non-E.E.C. Western European region, Africa, the Far East, the U.S., and the E.E.C., with Latin America and Canada supplying essentially no vegetables to this region. The Non-E.E.C. Western European region was the dominant supplier with approximately 43 percent of the market. By 1982 the Far East supplied 63 percent with the other major suppliers being the E.E.C., Latin America, and Canada. The shares of the Middle Eastern import market supplied by the U.S., Africa, and the Non-E.E.C. Western European region declined from 1962 to 1982 (see Tables C.1 and C.7).

Insights into these changes can be gained by examining the product demand and CIF price parameters for the Middle East (see Tables 6.8 and 6.9). The Non-E.E.C. Western European region and Africa both have statistically significant, inelastic market size parameters. Therefore as the Middle Eastern market grows, the shares supplied by these two regions will decline, given that prices remain unchanged. However, from 1962 to 1982 prices did not remain unchanged. Specifically, transportation costs underwent a great deal of change, increasing quite a bit in the early and late 1970s. These are captured in the CIF price linkage equations by the trend variable. It is revealing to note that this variable is statistically significant and highly elastic for the Middle Eastern CIF prices for both African and Non-E.E.C. Western European vegetables (see Table 6.9). Also, the Middle East has statistically significant, highly elastic price parameters on its product demands for both of these regions. Therefore, the CIF price linkage equation captures the increase in transportation costs , which is transferred to the market price of the products. For Africa and the Non-E.E.C. Western European region, the increased market price results in decreased demand for their products in the Middle East. Also it is quite likely that part of the decline in demand for Non-E.E.C. Western European vegetables was due to a decline in membership of that region and concurrent increase in the E.E.C. members.

The U.S. has statistically significant parameters for both price and market size. That for price is highly elastic while that for market size is only slightly larger than one. As the Middle Eastern market grows, the share supplied by the U.S. will do little more than maintain its status quo, given that prices remain unchanged. From 1962 to 1982, however, prices actually increased. Given that the price parameter on U.S. vegetables in the Middle East is highly elastic, it is probable that the U.S. price increases caused the U.S. share of the Middle Eastern market to decline. The Middle East's CIF price equation for U.S. vegetables indicates that transportation costs do not affect its CIF price, however, the FOB price has a positive, elastic effect.

The share of the Middle Eastern market supplied by the E.E.C. increased from 1962 to 1982. The product demand parameters indicate statistically significant, elastic responses on the part of Middle Eastern demand for this product with respect to price and market size. Therefore as the Middle Eastern market increased, the share composed of E.E.C. vegetables increased, without considering the price effect. As the price of E.E.C. vegetables increased, the demand for this product decreased. The CIF price equation reveals, however, that the CIF price of E.E.C. vegetables to the Middle East is not significantly affected by transportation and handling costs and the response to FOB

price changes is only slightly larger than unity. Thus, the major factors operating in the vegetable trade system to cause price increases are weak in the case of E.E.C. vegetables going to the Middle East. Therefore there would only be a very small drop in demand with any change in transportation costs or FOB prices. In the case of the E.E.C., this decrease was probably offset by its increased membership, bringing with it increased Middle Eastern demand.

The shares of the Middle Eastern market composed of Latin American and Canadian vegetables also increased. While some conclusions can be made on the basis of the demand parameters, the quantities involved in these trade flows were so small that the estimation results probably have little meaning. With regards to Latin America, the price parameter has an incorrect sign and is statistically insignificant, as is the market size parameter (see Table 6.8). The CIF price equation indicates that increases in both the FOB price and transportation costs would cause positive, elastic responses in the CIF price of Latin American vegetables to the Middle East. For Canada, the increase in demand was probably due to the increased size of the Middle Eastern vegetable market; this parameter is significant and elastic. Its price parameter is insignificant. Its CIF price linkage equation reveals that only a change in the FOB price would cause an increase in

the CIF price. The FOB price parameter is positive but inelastic.

Implications for World Vegetable Trade

The Middle East is expanding its involvement in international fresh vegetable trade. Its participation on both the import and export sides showed pronounced growth from 1962 to 1982 (see Tables 2.2 and 2.3). However, while its exports more than doubled, it is still a relatively small supplier of fresh vegetables. Its exports to the relatively small markets of Latin America, Africa, and the Far East increased. It did not make inroads into the established markets of the U.S., Canada, the E.E.C., or the Non-E.E.C. Western European region. In fact, the combined share of its exports to the European regions declined by 62 percent (see Tables C.8 and C.14). Thus it appears that the Middle East, as an exporter, does not pose much of a threat to established patterns of trade among the developed regions. However, it is highly competitive in the small, but growing, markets of the Third World.

Middle Eastern imports of fresh vegetables increased by more than three fold (see Table 2.2). It is a growth region of some importance for exporters. Empirical results indicate that increased product prices, brought about by increases in transportation costs or increased FOB prices, caused Africa, the Non-E.E.C. Western European region, and

the U.S. to decline in importance as suppliers to this region. The decrease in membership of the Non-E.E.C. Western European region contributed to its decline, while the opposite is true for the E.E.C. The increase in membership, along with the market size effect, led to increased penetration of the market by the E.E.C. The market size effect was the probable cause of Canada's increased participation in the Middle Eastern market. No conclusions can be reached regarding Latin America as the demand parameters are insignificant.

In summary, empirical results indicate that each region competing for a share of the Middle Eastern market has a different competitive advantage. In order to increase their shares, regions must recognize where they are most competitive and capitalize on it. If their price parameters are statistically significant and elastic, with the negative relationship of a normal good, then in order to increase their shares, they must become more competitive, perhaps by lowering transportation costs. Of course, this study does not deal with a wide array of marketing techniques useful for developing markets. If their market size parameters are statistically significant and elastic, then for some reason they are very competitive with respect to the other products. This could be due to product mix, quality, shipping or financial arrangements; any number of variables could affect this type of competitiveness. If a region

shows an inelastic parameter on market size, it needs to increase the competitiveness of its product. This can be done by working on any of the factors mentioned above.

Estimation Results with Respect to Africa

Africa's participation in international vegetable trade changed considerably from 1962 to 1982. In 1962 Africa had a very small import market but was a significant exporter. By 1982, while still not a major importer, the African vegetable market had shown itself to be one of the fastest growing import markets among the eight regions. Its exports, however, had declined to about 56 percent of its 1962 levels (see Tables 2.2 and 2.3). In 1962 Africa's primary suppliers and markets were the E.E.C. and the Non-E.E.C. Western European region. By 1982, while the E.E.C. still supplied the majority of Africa's imports, the Non-E.E.C. Western European region had declined in importance while the Middle East, the U.S., and Latin America had gained strong shares (see Tables C.1 and C.7). As for Africa's export markets in 1982, the E.E.C. was still its primary market but the Middle East had increased in importance. While the share of African exports that went to the E.E.C. increased slightly from 1962 to 1982, the absolute quantities dropped significantly and the share of the E.E.C.'s imports from Africa dropped from 61 percent to 3 percent (see Table C.14). Africa exports virtually no

vegetables to Latin America, Canada, the U.S., or the Far East.

African Exports

Africa's exports of fresh vegetables declined dramatically from 1962 to 1982. This was not due to lack of supply, its production increased by a rate of 1.69, the second highest rate among the eight regions (see Table 2.1). The parameters on Africa's export supply equation give some insight into the forces operating on Africa's exports (see Table 6.10). Both the price and production parameters are significant. Response to price is positive but inelastic; as the price received for Africa's vegetables on the world market increases, Africa's exports increase by a much smaller percentage. The production parameter, however, is negative and very elastic. As production increases, exports decrease by more than twice that amount. These results seem to indicate that from 1962 to 1982 the strength of domestic demand increased as production increased. Perhaps the types of vegetables being produced in Africa from 1962 to 1982 were shifting to ones more preferred domestically than previously. Or, it is possible that no shift in product mix occurred, just a growth in domestic demand. While the empirical evidence points to a trend of this sort, there is no definitive proof in this study as to exactly what occurred.

The product demand parameters for the E.E.C. demand for African vegetables give no clues as to why its demand for this product dropped (see Table 7.7). Both the price and market share parameters are insignificant. The parameters for the Non-E.E.C. Western European region's demand for African vegetables, however, are both significant and elastic. The relationship between the Non-E.E.C. Western European region's market size and its demand for African vegetables is positive. Therefore as this market declined in size due to a loss of members, its demand for African vegetables declined.

Thus, while the empirical evidence gives some clues as to what occurred with African exports, a great deal is left unexplained. Nevertheless, it cannot be disputed that Africa's importance as an exporter declined drastically from 1962 to 1982.

The percentage of African exports going to the Middle East increased from 2 to 24 from 1962 to 1982 (see Tables C.8 and C.14). The Middle East's product demand parameters indicate a statistically significant, negative, elastic price response to African vegetables. The market size parameter is positive and inelastic. The CIF price equation indicates that FOB prices affect the CIF price to the Middle East of African vegetables (see Table 7.8). However, the trend variable response is relatively small compared to those of the other regions supplying the Middle

TABLE 7.7

PRODUCT DEMAND PARAMETERS AND t STATISTICS OF ALL REGIONS FOR AFRICAN FRESH VEGETABLES.

	$\phi(0i7)$	$\phi(1i7)$	$\phi(2i7)$
Latin America	-18.552	-0.989	1.431
	(-.54)	(-.65)	(.75)
U.S.	-31.601	-0.481	2.279
	(-1.89)	(-.81)	(2.37)
Canada	54.660	1.058	-3.239
	(1.29)	(.67)	(-1.14)
E.E.C.	13.533	-0.400	-0.005
	(1.02)	(-.49)	(-.01)
Middle East	-3.697	-2.476	0.860
	(-.62)	(-1.90)	(2.43)
Far East	.	.	.
	(.)	(.)	(.)
Africa	.	.	.
	(.)	(.)	(.)
Non-E.E.C.	-95.287	-4.773	6.293
W. Europe	(-1.17)	(-4.12)	(1.31)

$$\log X(i7) = \log \phi(0i7) + \phi(1i7) \log P(i7) - \phi(1i7) \log P(i.) + \phi(2i7) \log X(i.)$$

Degrees of freedom for each of these equations is 18.

TABLE 7.8

CIF PRODUCT PRICE PARAMETERS AND t STATISTICS OF ALL REGIONS FOR AFRICAN FRESH VEGETABLES.

	$\Phi(0i7)$	$\Phi(1i7)$	$\Phi(2i7)$
Latin America	-625.990	0.699	82.507
	(-2.64)	(3.51)	(2.64)
U.S.	-181.680	0.597	23.924
	(-.96)	(3.08)	(.96)
Canada	-120.160	1.028	15.875
	(-.17)	(2.38)	(.17)
E.E.C.	-97.560	1.202	12.933
	(-.30)	(3.93)	(.30)
Middle East	-359.910	1.047	47.512
	(-.81)	(2.34)	(.81)
Far East	-729.150	0.694	96.066
	(-2.12)	(3.58)	(2.12)
Africa	.	.	.
	(.)	(.)	(.)
Non-E.E.C.	-506.750	0.806	66.791
W. Europe	(-3.11)	(7.71)	(3.11)

$$\log C(i7) = \log \Phi(0i7) + \Phi(1i7) \log F(i7) + \Phi(2i7) \log \text{Year}$$

Degrees of freedom for each of these equations is 18.

East. It also has a low t value indicating that it might be insignificant. These results likely reflect a lower transportation cost between these regions. The close proximity of Africa makes it unlikely that these costs are a substantial part of the CIF price of this product to the Middle East relative to more distant suppliers.

African Imports

Africa's importance as an importer grew a great deal from 1962 to 1982. It had the second highest rate of growth of imports among the eight regions, 4.18. This was above the world rate of 4.01 (see Table 2.2). This level of growth points to Africa as a key market to those regions wishing to expand their exports. The regions which increased the shares of their exports going to Africa from 1962 to 1982 were the Middle East, the U.S., Canada, and the E.E.C. The Far East and the Non-E.E.C. Western European region sent a smaller percentage of their exports to Africa in 1982 than in 1962. The Middle East and the E.E.C. showed the largest increases in their percentages, although those for Latin America and the U.S. were also significant (see Tables C.8 and C.14).

Africa's market demand equation yields some information as to why this region's level of imports is expanding so rapidly (see Table 6.7). All of the parameters except that on population are statistically insignificant.

The population parameter is, however, slightly larger than unity and, given the tremendous growth in population experienced by Africa, could account for the level of growth experienced by this market.

Africa's product demand and CIF price parameters also provide insights as to the forces operating in this region (see Tables 6.8 and 6.9). All of the significant price parameters are negative and elastic, while all of the market size parameters are positive, elastic, and significant. These indicate that as the African market for vegetables grows, all regions will be able to increase their exports to this region. The amounts will depend on this elasticity as well as that for relative prices and the CIF price relationships to the FOB price and the trend variable year. While all of the parameters on the CIF equations are not significant, for every equation at least one explanatory variable is statistically significant. Transportation costs have a particularly strong effect on the price of U.S., Canadian, and E.E.C. vegetables. The FOB price has a strong effect on the price of Non-E.E.C. Western European, Latin American, Far Eastern, Middle Eastern, and E.E.C. vegetables. All of these relationships operate in tandem to determine the shares of the African market made up of the different vegetable products.

The product elasticities seem to indicate that Middle Eastern vegetables are the most competitive product in the

African market. It has a highly elastic, positive market size parameter and a statistically insignificant price parameter. The CIF relationship indicates that the CIF price is only inelastically affected by FOB price increases and not affected by transportation costs. Thus, due to the market size elasticity, as the African market for vegetables grows, the share of it composed of Middle Eastern vegetables is likely to grow.

The E.E.C. is also an important supplier to the African market. Its market size parameter is fairly elastic. While its CIF price has a strong positive response to the trend variable, it has an inelastic response to the FOB price. Also, the relative price parameter on the African demand for E.E.C. vegetables, while negative and elastic, is only of moderate size. The U.S. and Canada, on the other hand, have larger negative price elasticities on the product demands, thus dampening African demand for these products. Latin America seems to have more of an advantage in the African market than do the U.S. and Canada. Its market size elasticity is higher, while the response of demand to relative prices is statistically insignificant. The response of its CIF price to the FOB price is higher, while that to transportation and handling costs is insignificant. The Far East market size response is the smallest of all regions and, while the trend variable does not appear to affect its CIF price, FOB prices do and its

product demand shows an elastic, negative response on the part of Africa to the market price of Far Eastern vegetables.

Implications for World Vegetable Trade

Africa lost most of its market shares of its important export markets from 1962 to 1982. The parameters on its export supply equation indicate vegetable production increases are being absorbed by the domestic market. Clearly Africa is becoming a net importer even with the growth in domestic production.

Africa's importance as an importer grew from 1962 to 1982; it was the second fastest growing region in the world (see Table 2.2). Empirical results indicate that all regions can expand their exports to Africa as this market grows. Empirical results also indicate that African price and market size responses are such that the Middle East and the E.E.C. will probably be able to increase their market shares easier than will the other regions. The Far East and Latin America also have advantages in this market regarding price and market size responses, more so than do the U.S. and Canada.

Estimation Results with Respect to the Non-E.E.C. Western European Region

The definition of the Non-E.E.C. Western European region changed over the study period, with the addition of

some of its members to the E.E.C. The loss of members is evident in this region's imports, which dropped by almost 50 percent from 1962 to 1982. Even so, it was still the third largest market for fresh vegetables. Exports increased almost three fold (see Table 1.1). These statistics indicate that the Non-E.E.C. Western European region is an important trader in fresh vegetables.

Non-E.E.C. Western European Exports

In 1982 the Non-E.E.C. Western European region was the fourth largest supplier of fresh vegetables for export (see Table 1.1). Its export supply parameters indicate statistically significant, although inelastic, relationships with supply and the average price received for these exports and production (see Table 6.10).

In 1962 the Non-E.E.C. Western European region exported 79 percent of its exports to the E.E.C., 9 percent to the Middle East, 6 percent to Africa, and 4 percent to Latin America. By 1982 it exported 97 percent to the E.E.C. and virtually nothing to the other markets (see Tables C.8 and C.14). The loss of these markets was probably due both to the strong demand by the E.E.C. for Non-E.E.C. Western European vegetables and the transportation costs involved in shipping to the Middle East and Latin America.

The product demand and CIF price equations are not very revealing as to why the E.E.C.'s demand for Non-E.E.C.

Western European vegetables is so strong. While the relative price response is statistically significant, it is positive (see Table 7.9). This is an unexpected result and one that is inconsistent with basic economic theory. There are several possible explanations for this incorrect sign, all of which have been mentioned earlier in this chapter. To repeat, possibly the E.E.C.'s demand for Non-E.E.C. Western European vegetables shifted right from 1962 to 1982 due to an increase in the quality of this vegetable product. Because of the small data set used in the estimation, the model would interpret this increase in both price and quantity as a positive relationship between the two variables when in fact the movement is not along a demand curve but to another level of demand. Another possibility is that the model is not performing well in this case and the sign is simply wrong. There could also be problems with the data. However, given that the E.E.C. and the Non-E.E.C. Western European region have very strong infrastructures for data collection and management, it is unlikely that data problems led to the positive price parameter. The more likely explanations in this case are quality changes or model problems.

The E.E.C.'s market size response to Non-E.E.C. Western European vegetables is statistically insignificant. Thus neither of the product demand parameters yield useful information as to why this trade flow grew to such an extent

TABLE 7.9

PRODUCT DEMAND PARAMETERS AND t STATISTICS OF ALL REGIONS FOR NON-E.E.C. W. EUROPEAN FRESH VEGETABLES.

	ϕ(0i8)	ϕ(1i8)	ϕ(2i8)
Latin America	-55.810 (-3.64)	-1.173 (-1.37)	3.691 (4.28)
U.S.	28.475 (1.02)	-2.158 (-1.44)	-0.991 (-.62)
Canada	33.942 (1.81)	-0.573 (-1.10)	-1.627 (-1.35)
E.E.C.	15.036 (.67)	1.851 (2.53)	-0.140 (-.11)
Middle East	-2.534 (-0.30)	-2.156 (-3.38)	0.739 (1.44)
Far East	-85.097 (-1.17)	-0.005 (-0.00)	4.742 (1.29)
Africa	. (.)	. (.)	. (.)
Non-E.E.C. W. Europe	. (.)	. (.)	. (.)

$$\log x(i8) = \log \phi(0i8) + \phi(1i8) \log P(i8) - \phi(1i8) \log P(i.) + \phi(2i8) \log X(i.)$$

Degrees of freedom for each of these equations is 18.

from 1962 to 1982. The CIF parameters indicate a positive, elastic, and statistically significant response to FOB prices and an insignificant response to the trend variable (see Table 7.10). This last parameter could possibly be the most revealing. Given the close proximity of the two regions, transportation and handling costs are probably not very high for products traveling betweem them. This would give Non-E.E.C. Western European vegetables a cost advantage over those products which have to travel long distances to arrive at the E.E.C. market. In Chapter VI it was discussed that the empirical results of this study seem to indicate that market shares are determined largely through price competition in the E.E.C.. Thus the negligible impact of transportation and handling costs would explain how the Non-E.E.C. Western European region was able to increase its exports to the E.E.C. by almost 20 percent.

Non-E.E.C. Western European Imports

In 1962 the Non-E.E.C. Western European region received imports from all regions except the Far East. By 1982 the Far East was the primary supplier to the E.E.C. All other regions had declined in their shares except Latin America. The E.E.C. supplied 76 percent of the Non-E.E.C. Western European region's imports in 1982, Latin America 7 percent. The U.S. and Canada supplied 5 and 3 percent, respectively (see Tables C.1 and C.7).

TABLE 7.10

CIF PRODUCT PRICE PARAMETERS AND t STATISTICS OF ALL REGIONS FOR NON-E.E.C. W. EUROPEAN FRESH VEGETABLES.

	$\Phi(0i8)$	$\Phi(1i8)$	$\Phi(2i8)$
Latin America	-535.280 (-2.44)	0.655 (3.84)	70.573 (2.44)
U.S.	-98.200 (-.13)	0.754 (.77)	12.988 (.13)
Canada	1367.910 (1.63)	1.432 (2.95)	-180.140 (-1.63)
E.E.C.	468.410 (.89)	1.217 (3.73)	-61.637 (-.89)
Middle East	-1018.210 (-3.49)	0.958 (5.12)	134.240 (3.49)
Far East	-133.920 (-1.01)	0.603 (2.98)	17.633 (1.01)
Africa	201.140 (.69)	1.519 (6.36)	-26.356 (-.69)
Non-E.E.C. W. Europe	. (.)	. (.)	. (.)

$\text{Log } C(i8) = \log \Phi(0i8) + \Phi(1i8) \log F(i8) + \Phi(2i8) \log \text{Year}$

Degrees of freedom for each of these equations is 18.

The product demand parameters do not reveal why the Non-E.E.C. Western European region's demand for E.E.C. vegetables grew from 20 percent of its import market to 76 percent. The relative price parameter, while statistically significant, is positive (see Table 7.8). This, again, either indicates a quality shift or model performance problems. The market size parameter is statistically insignificant. The CIF price parameters are both statistically significant, that for the FOB price response is positive and inelastic while that for the trend variable is negative and very elastic (see Table 7.9). This large negative CIF price response to the proxy for transportation and handling costs could be the reason for the growth in this trade flow. It is possible that technological advances lowered the costs of transporting vegetables from the E.E.C. to the Non-E.E.C. Western European region from 1962 to 1982. This would yield E.E.C. vegetables a cost advantage in the Non-E.E.C. Western European region.

The product demand and CIF price parameters give some insights as to why the Non-E.E.C. Western European region's demands for other products declined. While the price parameter for the U.S. is negative, elastic, and statistically significant, its market size elasticity is insignificant. Thus growth in the Non-E.E.C. Western European region's market for fresh vegetables has no impact on its demand for the U.S. product. The Middle East has

negative, elastic, and significant price and market size parameters, but it also has an extremely elastic response on the part of its CIF price to the trend variable. The same is true for Africa. Transportation and handling costs are apparently so high as to make these products unable to be price competitive. Canada's market size elasticity is statistically insignificant and it has a very elastic, 54.142, response on the part of its CIF price to the trend variable. Also, its relative price response, while significant, is positive. This result is either incorrect or there was a quality shift in this product.

Implications for World Vegetable Trade

The Non-E.E.C. Western European region is an important trader of fresh vegetables, even with the loss of members. The primary market for its exports is the E.E.C., receiving 97 percent of the Non-E.E.C. Western Europe's exports. Also, the E.E.C. is its primary supplier, although it does receive some imports from Latin America, Canada, and the U.S. There is nothing in the empirical evidence to indicate a change in these patterns. Its trade will probably remain primarily confined to the E.E.C. on both the import and export sides.

Estimation Results with Respect to the Far East

The Far East experienced the largest growth rates of both imports and exports of fresh vegetables among the regions studied. Its imports increased more than seven times over and its exports more than seventy (see Tables 2.2 and 2.3). This level of growth merits attention in order to discover the forces behind it and the implications it has for world wide vegetable trade.

Far Eastern Exports

On the export side, it is clear that growth was driven by demand and not supply. Nevertheless, the export supply equation shows Far Eastern exports to have very elastic, statistically significant responses to both its average export price and its level of production (see Table 6.10). The price response is negative. The increase in demand came primarily from one region, the E.E.C. In 1962 the Far East sent 31 percent of its exports to the E.E.C., 27 percent to the Middle East, 26 percent to Africa, and 7 percent to Latin America (see Table C.8). In 1982, 99 percent of Far Eastern exports went to the E.E.C. (see Table C.14). This increase in exports to the E.E.C. probably explains the positive price response in the export supply equation. As will be discussed, competition for market shares in the E.E.C. is largely based on price, the lower priced products obtain a larger market share.

The parameter estimates on E.E.C. product demands indicate that the E.E.C. has a price elasticity for Far Eastern vegetables of almost negative four (see Table 7.11). The E.E.C. CIF price response to Far Eastern FOB prices is positive, elastic, and statistically significant. That for the trend variable is also significant, but large and negative, which is an unlikely result. It is possible that technological changes and improvements in infrastructure have occurred which lowered the transportation and handling costs from the Far East to the E.E.C. However, the parameter size is so large as to make it unbelievable (see Table 7.12).

The parameter estimates for market size on E.E.C. product demands are all statistically insignificant, except for Latin American vegetables. Thus competition for market shares in the E.E.C. is essentially decided by price. This, together with the price elasticities, indicates why the Far East was able to increase its share of the E.E.C. market from 54 to 79 percent from 1962 to 1982, while that for Africa went from 61 to less than 3 percent and that for the U.S. went from 4.77 to 2.24 percent.

Far Eastern Imports

On the import side, it is clear that the Far Eastern market for vegetables expanded greatly from 1962 to 1982.

TABLE 7.11

PRODUCT DEMAND PARAMETERS AND t STATISTICS OF ALL REGIONS FOR FAR EASTERN FRESH VEGETABLES.

	$\phi(0i6)$	$\phi(1i6)$	$\phi(2i6)$
Latin America	-8.274 (-.21)	-2.242 (-1.27)	0.848 (.38)
U.S.	-48.192 (-2.23)	-1.285 (-2.90)	3.271 (2.63)
Canada	-24.874 (-1.81)	-0.508 (-.56)	2.079 (2.40)
E.E.C	27.181 (1.12)	-3.921 (-14.98)	-0.838 (-.63)
Middle East	. (.)	. (.)	. (.)
Far East	. (.)	. (.)	. (.)
Africa	-49.322 (-1.45)	-1.277 (-1.11)	3.142 (1.70)
Non-E.E.C. W. Europe	137.340 (1.71)	-0.070 (-.16)	-7.623 (-1.61)

$$\log X(i7) = \log \phi(0i7) + \phi(1i7) \log P(i7) - \phi(1i7) \log P(i.)$$
$$+ \phi(2i7) \log X(i.)$$

Degrees of freedom for each of these equations is 18.

TABLE 7.12

CIF PRODUCT PRICE PARAMETERS AND t STATISTICS OF ALL REGIONS FOR FAR EASTERN FRESH VEGETABLES.

	$\Phi(0i6)$	$\Phi(1i6)$	$\Phi(2i6)$
Latin America	-1177.490 (-6.24)	0.040 (.30)	155.130 (6.24)
U.S.	323.050 (.38)	2.885 (1.57)	-42.448 (-.38)
Canada	-401.190 (-.47)	0.874 (.68)	52.920 (.47)
E.E.C.	637.230 (4.49)	1.241 (9.28)	-83.852 (-4.49)
Middle East	-1645.790 (-1.46)	-0.363 (-.30)	216.620 (1.46)
Far East	. (.)	. (.)	. (.)
Africa	81.418 (.09)	0.916 (1.12)	-10.692 (-.09)
Non-E.E.C. W. Europe	-549.320 (-2.22)	1.139 (3.30)	72.529 (2.22)

$\log C(i6) = \log \Phi(0i6) + \Phi(1i6) \log F(i6) + \Phi(2i6) \log \text{Year}$

Degrees of freedom for each of these equations is 18.

While the market demand parameters do not reveal why this occurred, all are quite inelastic, the product demand parameters indicate very elastic responses in product demands to increases in the market size (see Tables 6.7 and 6.8). The product demands also show very elastic price responses in three cases. Thus the parameters on the Far Eastern region's product demands reveal it to be a very volatile market; quantities demanded change a great deal with price or market size changes.

In 1962 the major suppliers to this region were, in order of importance, Africa, the U.S., the E.E.C., the Middle East, and Oceania. By 1982 the Middle East and Oceania had increased their shares to 25 and 27 percent, Africa and the E.E.C. had decreased to 1 and 17 percent and the U.S. had remained essentially unchanged at 25 percent (see Tables C.1 and C.7). Oceania is not a major trader in the world market and therefore was not included in the estimations. The decrease in demand for E.E.C. vegetables was probably due to the elastic price responses in both the CIF relationship and the product demand relationship (see Tables 6.8 and 6.9). The increase in demand for Middle Eastern vegetables was also probably due to the very elastic price response in the product demand equation. As the relative price of Middle Eastern vegetables dropped, Far Eastern demand for that product increased. The U.S. was probably able to just maintain its share of the Far Eastern

market due to the inelastic price responses in both the product demand and the CIF equations and the relatively moderate response of the Far East's CIF price to increases in transportation costs from the U.S. The CIF equation reveals very little as to why Far Eastern demand for African vegetables declined.

Implications for World Vegetable Trade

Data from 1962 to 1982 reveal that the Far East has become a major supplier of fresh vegetables on the world market, supplying almost 58 percent of all that was traded among the eight regions in 1982 (see Table C.14). By far its largest customer was the E.E.C. with 99 percent of Far Eastern exports going to the European Community. The E.E.C., besides being the largest market for fresh vegetables in the world, also has one of the highest growth rates in imports (see Table 2.2). If the trends observed from 1962 to 1982 continue, Far Eastern exports of fresh vegetables to the E.E.C. will continue to grow, as will its share of that market.

The Far East is a growth market for fresh vegetables. While it is still small, 3.62 percent of all imports of fresh vegetables went to the Far East in 1982, it is the fastest growing market among the regions studied (see Tables 2.2 and C.7). Its market demand shows inelastic responses to changes in the average price of vegetables in the Far

East, income, or population levels (see Table 6.7). The relationships point to a stable, long term expansion of the Far Eastern market. Product demand functions indicate that, while growth of the Far Eastern market may be stable, the demands for the imports from the different regions are highly volatile with regards to changes in price or market size (see Table 6.8). Estimation results indicate that as this market grows, most regions will be able to increase their exports to it.

Estimation Results with Respect to the European Economic Community

The E.E.C. is a major participant in the world trade of fresh vegetables. The Common Agricultural Policy, CAP, of the E.E.C. has fundamentally altered the environment for trade in all agricultural commodities, fresh vegetables included. As such, this region's primary impact on vegetable trade is as an importer, although it is also one of the world's largest exporters of fresh vegetables.

European Economic Community Exports

The E.E.C. is a major exporter of fresh vegetables (see Tables 1.1 and 2.3). Its primary markets are Latin America, Africa, and the Non-E.E.C. Western European region (see Table C.14). Each of these markets are either small, not rapidly growing, or both. The parameters on these regions' product demands for E.E.C. vegetables indicate that as the

Latin American and African markets grow, their demands for E.E.C. vegetables will grow (see Table 7.13). Market size does not affect the Non-E.E.C. Western European region's demand for E.E.C. vegetables, this parameter is insignificant. Its price parameter is significant, elastic, and positive. Again this reflects a change in the quality level of the product, model performance problems, or data problems.

Given these characteristics of its major export markets, the fact that the parameter estimates for its export supply equation are all inelastic, and that its growth rate in exports is well below the world growth rate, it is unlikely that the E.E.C. will experience a large amount of growth in its exports in the near future (see Tables 2.3 and 6.10). Its share of the fastest growing import market in the world, the Far East, declined from 1962 to 1982 (see Tables C.1 and C.7). The parameters on the Far East's demand for E.E.C. vegetables reveal that the price and market size responses are both elastic, statistically significant, and of the appropriate size. The parameters for Far Eastern demands for other products, however, are more elastic, particularly with respect to market size. Therefore as the Far Eastern market grows, its demand for E.E.C. vegetables will increase, but not as much as will those for other products (see Table 6.8). The parameters on the U.S.'s demand for E.E.C. vegetables indicate that this

TABLE 7.13

PRODUCT DEMAND PARAMETERS AND t STATISTICS OF ALL REGIONS FOR E.E.C. FRESH VEGETABLES.

	ϕ(0i4)	ϕ(1i4)	ϕ(2i4)
Latin America	-35.154	0.481	2.577
	(-1.28)	(.47)	(1.68)
U.S.	11.290	-0.086	-0.098
	(1.05)	(-.55)	(-.16)
Canada	.	.	.
	(.)	(.)	(.)
E.E.C.	.	.	.
	(.)	(.)	(.)
Middle East	-19.783	-2.131	1.808
	(-5.88)	(-6.41)	(8.95)
Far East	-53.518	-1.265	3.285
	(-3.15)	(-2.29)	(3.77)
Africa	-31.334	-1.550	2.391
	(-2.57)	(-1.06)	(3.61)
Non-E.E.C. W. Europe	14.466	2.704	-0.106
	(1.28)	(3.08)	(-.16)

$$\log X(i4) = \log \phi(0i4) + \phi(1i4) \log P(i4) - \phi(1i4) \log P(i.) + \phi(2i4) \log X(i.)$$

Degrees of freedom for each of these equations is 18.

demand is unresponsive to price or market size. This trade is probably governed by trade regulations and agreements as a U.S. response to the CAP. Middle Eastern demand parameters for E.E.C. vegetables indicate an elastic response to both, and its CIF price parameters indicate no response to the trend variable (see Table 7.14). These characteristics indicate that the E.E.C. may be able to expand its exports to this market, and indeed, from 1962 to 1982 its share of the Middle Eastern market grew.

European Economic Community Imports

The E.E.C. is the world's largest market for fresh vegetables (see Table 1.1). This market is growing rapidly, possibly in large part due to its expansion in membership. The parameter estimates for its market demand equations show it to have inelastic responses to the average price of vegetables in the E.E.C.,income, and population (see Table 6.7). Its product demand parameters reveal that market shares of the E.E.C. vegetable market are strongly influenced by price competition; its price elasticities are very elastic and negative while its market size elasticities are almost all inelastic (see Table 6.8).

The CAP gives preferential treatment in the form of lower tariffs on products from the Middle East and Africa. The U.S., Canada, and Latin America do not receive preferential treatment. The estimation results indicating

TABLE 7.14

CIF PRODUCT PRICE PARAMETERS AND t STATISTICS OF ALL REGIONS FOR E.E.C. FRESH VEGETABLES.

	$\Phi(0i4)$	$\Phi(1i4)$	$\Phi(2i4)$
Latin America	8.494	0.995	-1.074
	(.05)	(8.42)	(-.05)
U.S.	-101.750	0.921	13.416
	(-1.64)	(13.68)	(1.64)
Canada	342.360	0.921	-45.135
	(1.11)	(2.62)	(-1.11)
E.E.C.	.	.	.
	(.)	(.)	(.)
Middle East	104.550	1.017	-13.740
	(.22)	(3.59)	(-.22)
Far East	313.840	1.318	-41.259
	(.29)	(1.56)	(-.29)
Africa	-191.790	0.737	25.249
	(-1.14)	(6.17)	(1.14)
Non-E.E.C.	56.409	0.990	-7.421
W. Europe	(1.65)	(35.46)	(-1.65)

$$\log C(i4) = \log \Phi(0i4) + \Phi(1i4) \log F(i4) + \Phi(2i4) \log \text{Year}$$

Degrees of freedom for each of these equations is 18.

that price competition is the primary means of increasing market shares in the E.E.C. is evidence that the CAP has lessened the ability of these regions to compete for shares of the E.E.C. market, and will likely continue to do so in the future.

The Middle East increased its share of the E.E.C. market slightly from 1962 to 1982 while Africa's share declined (see Table C.7). Estimation results do not yield much insight into why this occurred.

Implications for World Vegetable Trade

The E.E.C. is a major participant in world vegetable trade on both the export and import side. Its importance as an exporter, however, is limited. The E.E.C. is not participating in the growth of the Far East, Middle East, or African markets and its export markets are small, not rapidly growing, or both. On the import side, the E.E.C. is the world's largest market. Its CAP policies have a major impact on trading patterns, reducing the ability of the U.S., Latin America, or Canada to be price competitive in the E.E.C. Estimation results indicate that market shares are determined by price in the E.E.C. Negotiations to allow for freer trade of fresh vegetables with the E.E.C. would likely alter trading patterns in this commodity, allowing more trade with the Western regions.

Estimation Results with Respect to the United States

The United States is a major participant in the world economy in virtually all of its aspects. In agriculture, the U.S. is a major producer and a major supplier. The 1980's saw some shifts in world patterns of trade in all areas, agriculture included. Other regions are now giving the U.S. strong competition for shares of import markets, even where the U.S. has traditionally been the dominant supplier. This increased competition in trade implies that the U.S. must put more emphasis on maintaining and expanding its shares of foreign import markets. The U.S. must also look to expand in areas where it has not put a great deal of emphasis in the past. While the U.S. is not the world's largest producer, it experienced a fair amount of growth in its production and approximately doubled its exports of this commodity from 1962 to 1982 (see Tables 2.1 and 2.3). However, total world trade in fresh vegetables increased about three fold in this time period. Thus, the U.S., while increasing its absolute quantities of exports, did not keep up with the growth of world trade in this commodity.

United States Exports

In 1962 the major markets for U.S. exports were, in 1962, Canada, Latin America, the Non-E.E.C. Western European region, and the E.E.C. By 1982 they were Canada, Latin America, the E.E.C., and the Far East (see Tables C.8

and C.14). The shares of U.S. exports going to Latin America, the E.E.C., and the Far East increased, those to Canada and the Non-E.E.C. Western European region decreased. Nevertheless, the share of the E.E.C. market composed of U.S. exports declined and that for the Far East just maintained its status quo (see Tables C.1 and C.7). Thus, even in its major markets, U.S. exports did not keep up with the growth of trade in this commodity. The Middle East and Africa, while small markets, have been shown to be growth regions for fresh vegetable imports; the U.S. maintained its status quo in Africa while declining in the Middle East (see Tables C.1 and C.7).

The results of the regression analysis give some insight into the forces operating in U.S. exports of fresh vegetables. The parameters on the export supply equation reveal an elastic response to the average price received for exports, the second most elastic among the regions considered (see Table 6.10). All other regions, except the Far East, have inelastic price responses for this relationship. This possibly indicates that the U.S. sells higher quality vegetables than the other regions, or that its costs of production are higher. The export supply parameter on production was statistically insignificant, indicating that levels of production do not significantly affect levels of U.S. exports of this commodity.

Tables 7.15 and 7.16 present the product demand and CIF price parameters estimated for all regions for their demands for U.S. vegetables. The E.E.C. shows very elastic responses on the part of its CIF price of U.S. vegetables to changes in transportation costs, and on the part of its product demands to changes in the market price of U.S. vegetables. Given that transportation costs increased markedly from 1962 to 1982, these elasticities alone would indicate that the U.S. has difficulty competing for a share of the E.E.C. market. However, these elasticities, coupled with the CAP and the results showing that price competition determines market shares in the E.E.C., are evidence that the U.S. is at a disadvantage in the E.E.C. market. Because the E.E.C. is the largest market for fresh vegetables, in order to increase its exports in both the long and short run, the U.S. must find a way to be price competitive in that market.

The Far East shows inelastic responses to prices of U.S. vegetables at the market and FOB levels and an elastic market size response. These probably explain why the U.S. was able to maintain its market share in that region, in the face of a very elastic response to transportation costs. If oil prices continue to remain relatively low, as they did in 1986, and if technology improves so as to lower the costs of transporting fresh vegetables, the U.S. will be able to compete strongly in the Far Eastern market.

TABLE 7.15

PRODUCT DEMAND PARAMETERS AND t STATISTICS OF ALL REGIONS FOR U.S. FRESH VEGETABLES.

	ϕ(0i2)	ϕ(1i2)	ϕ(2i2)
Latin America	.	.	.
	(.)	(.)	(.)
U.S.	.	.	.
	(.)	(.)	(.)
Canada	-4.513	-0.523	1.162
	(-2.47)	(-5.58)	(9.72)
E.E.C.	7.708	-4.079	0.393
	(.18)	(-2.82)	(.16)
Middle East	-8.275	-1.841	1.077
	(-1.33)	(-1.84)	(2.75)
Far East	-81.495	0.955	4.716
	(-3.33)	(.70)	(3.77)
Africa	-55.215	-2.567	3.683
	(-2.05)	(-3.71)	(2.53)
Non-E.E.C. W. Europe	-13.249	-5.348	1.529
	(-.16)	(-1.57)	(.31)

$$\log X(i2) = \log \phi(0i2) + \phi(1i2) \log P(i2) - \phi(1i2) \log P(i.) + \phi(2i2) \log X(i.)$$

Degrees of freedom for each of these equations is 18.

TABLE 7.16

CIF PRODUCT PRICE PARAMETERS AND t STATISTICS OF ALL REGIONS FOR U.S. FRESH VEGETABLES.

	Φ(0i2)	Φ(1i2)	Φ(2i2)
Latin America	-103.570	0.690	13.625
	(-.26)	(1.82)	(.26)
U.S.	.	.	.
	(.)	(.)	(.)
Canada	-462.120	0.781	60.883
	(-3.15)	(5.27)	(3.15)
E.E.C.	-494.160	0.558	65.081
	(-2.20)	(2.57)	(2.20)
Middle East	383.060	1.775	-50.389
	(.23)	(1.15)	(-.23)
Far East	-469.380	0.752	61.850
	(-3.79)	(7.95)	(3.79)
Africa	-738.760	-0.016	97.282
	(-1.37)	(-.03)	(1.37)
Non-E.E.C.	142.020	1.280	-18.640
W. Europe	(.47)	(4.99)	(-.47)

$\log C(i2) = \log \Phi(0i2) + \Phi(1i2) \log F(i2) + \Phi(2i2) \log \text{Year}$

Degrees of freedom for each of these equations is 18.

The Middle East has elastic, negative price responses on both the market and FOB levels. Even though it also has an elastic market size parameter, the price responses clearly outweigh the market size response, leading to a decrease in the U.S. share of the Middle Eastern market. Africa has a very elastic market size response. Although it also has elastic market price and transportation parameters, these are overpowered by the market size elasticity, leading to an increased market share for the U.S. Again, with both of these markets, if transportation costs can be lowered, the U.S. will be able to compete more effectively for market shares.

Latin America and Canada have traditionally been supplied by U.S. products and show no sign of changing that pattern. Canada is very price inelastic with regards to U.S. vegetables and very elastic with respect to its market size. Therefore, as the Canadian market grows, so will its demand for U.S. vegetables. Canada shows a fairly strong growth rate for imports (see Table 2.4). Latin America is not a particularly strong growth market, but the U.S. share of this market increased from 1962 to 1982.

United States Imports

The U.S. is not a major import market for fresh vegetables. In 1962 it imported approximately 8 percent of

world imports of this commodity; in 1982, about the same (see Tables C.1 and C.7). Its market demand parameters indicate that the average price of vegetables in the U.S., and income, are significant in explaining the variation in U.S. market demands. The response to both of these variables is, however, inelastic. Population is statistically insignificant.

The major suppliers of the U.S. market are Latin America and Canada. In 1962 the E.E.C. also supplied a fair amount; by 1982 its share was negligible. Together Latin America and Canada comprised almost 100 percent of U.S. imports in 1982 (see Tables C.1 and C.7).

The likely explanation for the dominance of the U.S. market by Latin America and Canada is their close proximity and the resulting low transportation costs. The CIF price parameters indicate statistically significant, highly elastic responses of the CIF prices to transportation costs in all cases except the Far East and the Non-E.E.C. Western European region (see Table 6.9). However, the quantities involved in these cases are so small as to render any parameter estimates questionable. It is quite likely that transportation costs do have a major impact on the CIF price of their products to the U.S.

The demand parameters on E.E.C. vegetables indicate that neither price nor market size affect U.S. demand for this product (see Table 6.8). These results, coupled with

the decline in the percentage of the U.S. market composed of E.E.C. vegetables, indicates market interference in this trade pattern. It seems likely that, as opposed to allowing market forces to operate in the importing of E.E.C. vegetables, the U.S. has negotiated trade agreements with the E.E.C. These trade agreements seem to have limited the E.E.C.'s ability to export to the U.S.

The product demand and CIF price parameters indicate that, if transportation costs can be lowered, and if the U.S. market for fresh vegetables grows, most regions will be competitive in this market. Almost all the demand parameters are statistically significant and elastic, indicating strong responses on the part of U.S. product demands with respect to prices and market size.

Implications for World Vegetable Trade

The U.S. is a strong participant in world vegetable trade. Nevertheless, its growth on both the import and export side has been below the world average. Transportation costs appear to be a major factor hindering U.S. trade, particularly with the growing markets of the Middle East, the Far East, and Africa. It is possible that technological advances will, in the long run, reduce the costs of transporting fresh vegetables. These will allow the U.S. to be more price competitive in these growing markets, and allow their products to be more competitive in the U.S. market.

However, in order to compete effectively in the E.E.C., the largest vegetable market in the world, changes are necessary in the CAP. Estimation results indicate that price competition largely determines market shares in this region. The CAP, coupled with high transportation costs, places the U.S. at a disadvantage with respect to the Middle East, the Far East, and Africa, which receive preferential treatment and are in close proximity to the E.E.C.

From 1962 to 1982 the largest markets for U.S. vegetables, and the main suppliers to the U.S., were Latin America and Canada. However, changes in the CAP and reduced transport costs could result in greatly expanded potential for U.S. exports and imports, allowing it to compete more effectively in the E.E.C., the Non-E.E.C. Western European region ,the Middle East, the Far East, and Africa.

Summary

This chapter has discussed the implications of the estimation results for each region with respect to exports, imports, and patterns of trade. The discussion has given insight as to the economic forces at work causing the patterns of trade observed in Chapter II. It has also given indications as to the likely future directions of fresh vegetable trade, given that economic conditions remain closely parallel to those prevailing from 1962 to 1982. This chapter also attempted to tie the model parameters and actual trading patterns together.

Chapter VIII will discuss results of simulations where one or more exogenous variables are shocked. Combined with the trends indicated in Chapter VII, these simulations will clearly illustrate the strength and importance of the major economic variables included in the world trade model for fresh vegetables.

Chapter IX will summarize the dissertation's discussion. The goals outlined in Chapter I will be reviewed as to how well the study completed them. The major patterns of trade and the economic forces behind them will also be reviewed. Implications for policy makers, particularly from a U.S. point of view, will be discussed.

CHAPTER VIII

SIMULATION RESULTS AND THEIR IMPLICATIONS FOR WORLD VEGETABLE TRADE

Introduction

The world trade model outlined in this dissertation was estimated and the results and their implications discussed in the previous two chapters. The results lend many insights as to the forces operating to drive international vegetable trade among the eight regions. These were discussed extensively in Chapter VII.

The estimated parameters measure the strength of the relationships between the explanatory and dependent variables. They can be used to simulate the impacts of changes in explanatory variables on the dependent variables. This is a very important component of any analysis as economic variables are not static, they are constantly in flux.

Simulations were carried out on the world vegetable system which dealt with the demand side, the supply side, and the relationship between CIF import prices, FOB export prices, and transport and handling costs. Explanatory variables in each of the four types of functional relationships in the system, market demands, product

demands, export supplies, and CIF import prices, or equations (6.1), (6.2), (6.3), and (6.4) were varied and the impacts on their dependent variables measured.

The simulations were done on an equation by equation basis. Impacts on the entire system with a change in an explanatory variable in one of the equations were not measured. The reason for this approach is that the system is very large and highly nonlinear. It was not possible, with current procedures and options within SAS, to simulate this system in a simultaneous manner.

Because the simulations were carried out strictly on an equation by equation basis, where actually all the variables are determined simultaneously, the impacts measured are only partial effects. To capture the total effects, the simulations would have to be carried out taking account of the effects on the whole system. This is because a change in an independent variable in one equation would affect all dependent variables in the trade system.

This chapter discusses the results of the simulations. Each type of relationship, market demands, product demands, export supplies, and CIF import prices, is discussed separately. Each is discussed with respect to the eight regions. Therefore the impacts of the same change in an explanatory variable in the same type of relationship is discussed for each region. The differences in these impacts further differentiate and distinguish the regions according

to the characteristics of the economic forces driving their participation in international vegetable trade.

Market Demands

Market demands measure the strength of the relationships between total demand for fresh vegetables in a region and their average market price, the region's GDP and population level. It is specifically expressed in (4.18) and (6.1), or to repeat,

$$(8.1)\ \log X(i.) = \log \delta(0i) + \delta(1i) \log P(i.) + \delta(2i) \log GDP(i) + \delta(3i) \log Pop(i)$$

Two types of simulations were carried out on market demands. In the first, the average market price of vegetables was varied from 50 percent to 150 percent of its actual value in 1982, in increments of 10 percent. All other variables were held constant. The 1982 price level was chosen as the one with which to begin the price variations because it was the last year of the data set. It is likely that the average market prices of vegetables did rise after 1982. Thus the simulation is based on realistic expectations, with the idea to obtain probable results of these price increases. Eleven scenarios were implemented measuring the impacts of changes in the average market price of fresh vegetables on market demands. In the second type of simulation, regional GDPs and populations were varied

simultaneously. This type of simulation was carried out in two groups, A and B, where the variations in the variables were different in each. The first set, group A, used changes in GDP and population which reflected trends observed in the data over time. These observed changes in GDP and population were then multiplied by from 1 to 10, in increments of 1, simulating continuation of observed trends. Because the base level of changes in the independent variables reflected actual regional patterns of change, variations simulated for these variables were not all equivalent from region to region in group A of the simulations. In the second set, group B, the populations again were varied according to realistic proportions, but all GDPs were varied by multiples of 3 percent. This may not be a realistic scenario for some regions. It is useful, however, to simulate the changes in regional market demands which would be observed if all GDPs grew at the same rate. The changes reflect the relative strengths of the market demands across regions. In each of the two groups of simulations of changes in GDPs and populations, eleven scenarios were carried out.

Simulations Involving the Average Market Price

In these simulations, the 1982 regional average market prices of vegetables were varied from 50 to 150 percent of the market price for that base year. The impacts on

regional market demands were measured using the parameters calculated in the nonlinear 2SLS estimation of the trade system. To facilitate understanding the extent of the impact of the price variations, indices of the market demands were calculated. With the market demand predicted by the model for 1982 as the denominator, or base line, and the simulated market demand as the numerator, an index is an easy way to measure the change brought about by the simulated price changes.

Table 8.1 presents the indices for each region, for each price variation. The left most column indicates the percentage of the 1982 market price used to obtain the simulated market demands. When the index equals 1.000, the simulated market price is equal to the actual price. Note that the price parameters for the Middle East, the Far East, Africa, and the Non-E.E.C. Western European region are statistically insignificant (see Table 6.7). Thus the results of these simulations are unreliable. Because the null hypothesis of no relationship between market demand and price cannot be rejected for these regions, theoretically their market demands would be unaffected by changes in the average price of vegetables. Consequently, simulation results for these regions will not be discussed.

The results for the other regions are not surprising when the market demand parameters, presented in Table 6.7, are considered. Regions 1,2, and 4 or Latin America, the

TABLE 8.1

INDICES OF MARKET DEMANDS WITH VARYING AVERAGE MARKET PRICES.

% of 1982 Average Market Price	Latin America	U.S.	Canada	E.E.C.	Middle East	Far East	Africa	Non-E.E.C. W. Europe
50	1.371	1.348	0.922	1.649	3.467	0.868	0.992	1.081
60	1.262	1.246	0.942	1.446	2.484	0.901	0.994	1.059
70	1.176	1.166	0.959	1.294	1.887	0.930	0.996	1.041
80	1.107	1.101	0.974	1.175	1.488	0.960	0.998	1.026
90	1.049	1.046	0.988	1.079	1.206	0.979	0.999	1.012
100	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
110	0.958	0.960	1.011	0.934	0.844	1.020	1.001	0.989
120	0.920	0.924	1.022	0.877	0.723	1.038	1.002	0.980
130	0.887	0.893	1.031	0.827	0.627	1.055	1.003	0.971
140	0.858	0.865	1.040	0.784	0.549	1.071	1.004	0.963
150	0.832	0.840	1.049	0.746	0.486	1.086	1.004	0.955

U.S., and the E.E.C. all show indices greater than 1 for market prices below the 1982 level and indices less than 1 for prices above the 1982 level. That is, they reflect the negative relationship between price and quantity expected by economic theory and shown to apply in these cases by their negative price elasticities. Region 3, Canada, is the opposite; when prices are below the 1982 level, demand is smaller than the 1982 level, and vice versa. However, the absolute change is very small. Probably the positive effect is really no different from zero. The ranges of the indices reflect the relative sizes of the price elasticities. Among those regions with a negative price relationship, the simulation indices show that the market demands for Latin America and the U.S. would vary at approximately the same rates while the variation in the E.E.C. market demand would be somewhat larger.

Simulations Involving GDP and Population Levels

In these simulations, regional GDPs and populations were varied simultaneously. This was completed in two groups, A and B. First both GDPs and population were varied in multiples of regional percentage changes observed in the data, group A. The second simulation, group B, varied all regional GDPs in multiples of 3 percent, with the populations varied according to realistic trends (see Table 8.2). The increases in GDP observed in the data for the

TABLE 8.2

GDP AND POPULATION SIMULATIONS.

Region		GDP(in %)		Population(in %)	
Number	Name	Group A	Group B	Group A	Group B
1	Latin America	1	3	3	3
2	U.S.	8	3	1	1
3	Canada	4	3	1	1
4	E.E.C.	10	3	1	1
5	Middle East	30	3	3	3
6	Far East	20	3	4	4
7	Africa	20	3	3	3
8	Non-E.E.C. W. Europe	20	3	.5	.5

E.E.C., Middle East, Far East, Africa, and the Non-E.E.C. Western European region are very high. An explanation for these large increases for the Middle East could be the huge increases in oil revenues in the 1970's and early 1980's. This trend, however, has not continued. Oil revenues in 1985 and 1986 probably did not yield a growth rate in GDP of twenty percent for the Middle East. For the Far East and Africa an explanation for the large increases in GDP could be the rapid expansion of economic development that took place in at least some sectors of their economies. In Africa, in particular, although there is much poverty throughout the continent, in the cities, economic development projects were undertaken which raised income levels in some sectors. It is possible that these were the sectors included in the statistics and that the other, poorer parts of the economy were excluded. This could lead to the very high increases in GDP shown in the data.

GDP and population levels varied according to realistic proportions

This simulation, group A, varied both GDPs and populations according to trends observed in the data. The ratios of the simulated market demands to the market demand predicted by the nonlinear 2SLS estimation of the model are presented in Table 8.3. There are eleven observations for each ratio, corresponding to the eleven multiples of observed trends simulated. The first observation for each

TABLE 8.3

INDICES OF MARKET DEMANDS WITH VARYING GDP AND POPULATION LEVELS.

Increment N	Simulation Scenario	Latin America	U.S.	Canada	E.E.C.	Middle East	Far East	Africa	Non-E.E.C. W. Europe
0	A[a]	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
0	B[b]	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1	A	0.997	1.045	1.012	1.017	1.713	1.027	1.024	1.013
1	B	1.006	1.014	1.023	1.007	0.829	1.030	1.029	1.006
2	A	0.995	1.089	1.024	1.034	2.493	1.054	1.049	1.026
2	B	1.011	1.027	1.046	1.014	0.690	1.060	1.059	1.013
3	A	0.993	1.130	1.038	1.049	3.270	1.081	1.074	1.037
3	B	1.017	1.041	1.070	1.021	0.578	1.090	1.088	1.019
4	A	0.990	1.171	1.054	1.064	3.994	1.108	1.010	1.048
4	B	1.022	1.053	1.096	1.028	0.486	1.120	1.117	1.258
5	A	0.988	1.210	1.070	1.078	4.631	1.135	1.125	1.058
5	B	1.028	1.066	1.122	1.035	0.411	1.149	1.146	1.032
6	A	0.986	1.247	1.087	1.092	5.166	1.161	1.151	1.068
6	B	1.033	1.078	1.149	1.042	0.349	1.178	1.175	1.039
7	A	0.985	1.284	1.106	1.105	5.593	1.188	1.178	1.078
7	B	1.038	1.091	1.177	1.048	0.297	1.207	1.204	1.045
8	A	0.983	1.319	1.125	1.117	5.915	1.215	1.204	1.087
8	B	1.043	1.102	1.206	1.055	0.254	1.236	1.234	1.051
9	A	0.981	1.353	1.145	1.129	6.138	1.241	1.230	1.096
9	B	1.048	1.114	1.236	1.062	0.219	1.264	1.263	1.058
10	A	0.980	1.387	1.166	1.141	6.274	1.268	1.257	1.105
10	B	1.053	1.125	1.267	1.068	0.188	1.292	1.292	1.064

[a] A = N * (Actual Percentage) * GDP 1982, N * (Actual Percentage) * Population 1982

[b] B = N * (3 Percent) * GDP 1982, N * (Actual Percentage) * Population 1982

region's ratio is 1.000, thus giving a base line for comparing the remaining values.

Looking closely at observations 2 through 11, region 1, Latin America, shows ratios of less than 1, the only region to do so. This result, however, is flawed as the population parameter, which is negative, is statistically insignificant (see Table 6.7). Therefore the null hypothesis that population does not affect market demand cannot be rejected. A more likely simulation on Latin American market demands would vary only GDP and look at its impact. Because the parameter on this variable is positive, market demand would increase. Data from 1962 to 1982 show GDP to be increasing by approximately 1 percent in Latin America. Because its parameter is .430, market demand would increase about .043 percent a year.

The region which shows the largest ranges in its ratios is the Middle East. These results, however, are suspect as all the Middle East market demand parameters are statistically insignificant. The reasons behind the strong simulated growth lie in the sizes of its GDP and population elasticities, and the trends occurring in both of these aspects of Middle Eastern societies. Its elasticities are 3.119 and -9.481, respectively (see Tables 6.7 and 8.2). While the population response of market demand is negative, the strong growth in GDP, ten times that in population, overcomes the dampening effect of population. However, as

previously discussed, GDP in the Middle East is probably not currently growing at twenty percent. So while the first few scenarios may somewhat reflect what happened in the Middle East in those years after 1982, beyond the fifth scenario, which would represent 1986, they probably do not. This is also likely the case for the Far East, Africa, and the Non-E.E.C. Western European region, which showed large increases in GDP in the data set. It is unlikely that these increases continued for more than a few years after 1982. Scenarios simulating them as many as ten years into the future are probably unrealistic.

All other regions, the U.S., Canada, the E.E.C., the Far East, Africa, and the Non-E.E.C. Western European region, show moderate growth rates with the simulations in GDP and population. The U.S. shows the next largest ratio, after the Middle East, at 1.387. It would be even larger if its population parameter, which is negative but statistically insignificant, were not included in the simulation. The second smallest ratio, after Latin America, is that of the Non-E.E.C. Western European region and it is 1.105. The Far East and Africa are after the U.S., followed by Canada and the E.E.C. Thus the simulations on market demand, allowing for multiples of trends observed in the data for GDP, show the Middle East to have the largest potential rate of growth in demand for fresh vegetables. This region is followed by the U.S., the Far East, Africa,

Canada, the E.E.C., and Latin America (see Table 8.3). The simulated market demand for the Far East would be larger except for the negative, insignificant, parameter on GDP. Africa has two insignificant parameters, those on price and GDP. Neither Canada nor the E.E.C. have insignificant parameters, thus the simulation results are more believeable for these two regions.

These simulation results do not correspond to the regions which were shown in Chapter II to be the largest import markets. In that case, the fastest growing regions were the Far Eastern and the European regions, followed by Africa, the Middle East, and the U.S. (see Table 2.3). However, the Middle East and Africa also show the largest growth in production (see Table 2.1). Thus, while the Middle East shows very strong growth potential based on the simulations, its capability of supplying its own needs is growing. Regions wishing to capture a share of the Middle Eastern market will have to compete with within region supplies. This also holds true, to some extent, for Africa. While the market demands in the Far East and European regions do not show major growth potential, they are increasing and the capabilities of supplying themselves, while also growing, are not growing as rapidly. Therefore they show strong growth in imports.

All GDP levels varied by 3 percent, population levels in realistic proportions

This set of simulations, group B, varied both GDPs and populations; all regional GDPs in multiples of 3 percent while populations were varied according to the same realistic proportions used in the first set of simulations (see Table 8.2). The results are presented in Table 8.3, again in ratio form.

In these scenarios all regions show at least some growth with the exception of the Middle East, whose market demands for vegetables decline drastically. Because this region's market demand parameters are statistically insignificant, the results of this simulation are probably not valid. It is clear, however, that they are a result of its demand responses to GDP and population as discussed in the previous section. These two sets of simulations on market demands seem to indicate that the large increases in GDP experienced by the Middle East are driving its growth in demand for fresh vegetables. The elasticities observed on its market demand equation are further evidence that this is indeed the case (see Table 6.7).

A growth of 3 percent in GDP is unrealistic for all eight regions. For Latin America it is too high, for all others, too low. Latin America's demand for fresh vegetables shows some growth in these scenarios, its ratio reaching a high of 1.053. Nevertheless, given that a growth

rate of 3 percent in GDP is three times that observed for this region, and even with this level of growth in GDP its market demand grows only slightly, Latin America does not appear to have much potential for growth in its demand for fresh vegetables within the range of scenarios considered.

Canada, the Far East, and Africa have negative elasticities with respect to GDP (see Table 6.7). Consequently, in scenarios where GDP increased in multiples of 3 percent, their market demands for vegetables increase over those where GDP increased in multiples of realistic trends. This parameter for the Far East and Africa is statistically insignificant, for Canada it is significant. Therefore the simulation results are less reliable for the Far East and Africa. For the remaining regions, the U.S., the E.E.C., the Far East, Africa, and the Non-E.E.C. Western European region, their market demand increases in this second set of scenarios are smaller than the increases in the first set, as can be seen in the smaller corresponding ratios. Overall, however, the indices do give some insight into the potential for relative growths across the regions.

Product Demands

Product demands measure a region's demand for its own or another region's vegetables. Recall that the model used

for this study distinguishes products by their region of production. Product demands are specifically expressed in (6.2), or to repeat,

$$(8.2)\ \log X(ij) = \log \phi(0ij) + \phi(1ij) \log P(ij) - \phi(1ij) \log P(i.) + \phi(2ij) \log X(i.)$$

Note that a region's product demands are a function of the size of its market demand. For this reason, the two sets of simulations carried out on the market demands, discussed in the previous section, were also carried out on selected product demands. Product demands are also a function of product prices. Therefore simulations were also conducted varying product prices. The product demands selected were based on the patterns of flow of vegetables observed in Chapter II. Those patterns which account for a large percentage of vegetable trade, or which appear to have large growth potential, were selected. That included these thirty-one product demands: Latin America's demand for Canadian, European Community, and Non-E.E.C. Western European vegetables; Canada's demand for Latin American and U.S. vegetables; the E.E.C.'s demand for all products except its own and those of the Middle East; the Middle East's demand for U.S., E.E.C., African, and Non-E.E.C. Western European vegetables; Africa's demand for U.S., E.E.C., Middle Eastern, and Far Eastern vegetables; and the Non-E.E.C. Western European region's demand for vegetables from all regions except itself and Latin America.

Simulations Varying Market Demands

The simulation results for product demands with varying market demands are presented in Tables 8.4 to 8.19. Ratios for all three sets of simulations for each of the product demands selected are in the tables. The ratios are composed of the simulated product demands divided by the demand predicted by the nonlinear 2SLS model.

In the first set of simulations, the average market prices were varied from 50 to 150 percent of their 1982 levels. These price variations affect product demands in two ways. There are the direct impacts via the relative price ratios and more indirect impacts via the effects of the price variations on market sizes, which then impact each product demand.

The second and third groups of simulations involve variations of GDP and population levels. In the second, they were both varied in percentages observed to be occurring in the data. In the next, all regional GDPs were varied by 3 percent and population levels by the observed trends. These variations in GDP and population levels directly impact regional market sizes, which then impact regional product demands. Results for all three sets of simulations will be discussed on a regional basis.

Latin American product demands with varying market demands

Recall that Latin American market demands increase with a decrease in the average market price and decrease with an increase (see Table 8.1). These changes are, however, only moderate, with a demand increase of approximately 10 percent as prices decrease by 20 percent. This reflects the negative, inelastic price parameter on the market demand equation (see Table 6.7). The t statistic on this parameter is considerably larger than 1 and so these simulated impacts are probably statistically valid.

The product demand responses to variations in the average market prices are more extreme than those of the market demand (see Table 8.4). Latin America's demand for Canadian vegetables increases by almost 30 percent of its 1982 level when the price was decreased by 10 percent. These results are suspect as the product demand parameters on both price and market size have t values less than one. The demand response for E.E.C. vegetables is less extreme, but large nevertheless. It increases by 19 percent with a price decrease of 10 percent. These results are also suspect as the relative price parameter has a very small t value. The smallest changes are observed in the demand for Non-E.E.C. Western European vegetables, with an increase of only 5 percent when price was decreased by 10 percent. Both of the product demand parameters are statistically significant. Combined with the statistically significant market size responses to average price variations, the

TABLE 8.4

INDICES OF LATIN AMERICAN PRODUCT DEMANDS WITH VARYING AVERAGE MARKET PRICES.

% of 1982 Average Market Price	Canadian Product	E.E.C. Product	Non-E.E.C. W. European Product
50	4.851	3.146	1.421
60	3.202	2.327	1.295
70	2.254	1.804	1.198
80	1.663	1.446	1.120
90	1.271	1.190	1.055
100	1.000	1.000	1.000
110	0.805	0.854	0.953
120	0.660	0.740	0.912
130	0.550	0.648	0.876
140	0.465	0.573	0.843
150	0.397	0.512	0.814

simulated responses of Latin American demand for Non-E.E.C. Western European vegetables are the most statistically believable simulations for this region's product demands.

Latin America is the only region to show a decrease in market demand with simulations of observed trends in GDP and population (see Table 8.3). Its product demands also show a decline (see Table 8.5). These results are compromised by the insignificant and negative population parameters in Latin America's market demand. The simulated values for market size would be larger if population were not included, and thus all simulated product demands would be larger. Product demands for Canadian and Far Eastern vegetables show an insignificant market size parameter and those for E.E.C., Middle Eastern, and African vegetables show insignificant price parameters. Demands for Canadian and Far Eastern vegetables would be smaller if market size had not been included in their simulations, demands for E.E.C. and Middle Eastern vegetables would be smaller, and demands for African vegetables would be larger if price had not been included. In the first group of simulations Latin America's demand for Canadian, E.E.C., and Non-E.E.C. Western European vegetables all decline. This is the group of scenarios where GDP was increased in multiples of 1 percent and population in multiples of 3 percent. In the second set, GDP was increased in multiples of 3 percent as was population. The product demands all increase slightly in this group of scenarios.

TABLE 8.5

INDICES OF LATIN AMERICAN PRODUCT DEMANDS WITH VARYING GDP AND POPULATION LEVELS.

Increment N	Simulation Scenario	Canadian Product	E.E.C. Product	Non-E.E.C. W. European Product
0	A[a]	1.000	1.000	1.000
0	B[b]	1.000	1.000	1.000
1	A	0.997	0.993	0.990
1	B	1.006	1.015	1.022
2	A	0.995	0.987	0.981
2	B	1.012	1.030	1.043
3	A	0.992	0.981	0.973
3	B	1.018	1.044	1.064
4	A	0.990	0.975	0.965
4	B	1.023	1.059	1.085
5	A	0.988	0.970	0.958
5	B	1.029	1.073	1.106
6	A	0.986	0.965	0.951
6	B	1.034	1.087	1.127
7	A	0.984	0.961	0.944
7	B	1.039	1.101	1.148
8	A	0.982	0.957	0.938
8	B	1.044	1.115	1.168
9	A	0.981	0.953	0.933
9	B	1.049	1.128	1.189
10	A	0.979	0.949	0.927
10	B	1.054	1.142	1.290

[a] A = N * (Actual percentage) * GDP 1982,
N * (Actual Percentage) * Population 1982

[b] B = N * (3 Percent) * GDP 1982,
N * (Actual Percentage) * Population 1982

United States product demands with varying market demands

The United States has moderate increases and decreases in its market demands with decreases and increases in the average market price (see Table 8.1). These changes reflect the negative, inelastic price parameter in its market demand equation (see Table 6.7). The t statistic for this parameter is slightly larger than 1 and so is probably statistically significant. Therefore these simulated changes are probably valid.

U.S. product demands for Latin American vegetables increase by almost 30 percent when the average market price in the U.S. for fresh vegetables is decreased by 20 percent (see Table 8.6). The results are probably believable as the t statistics on both the relative price and market size parameters are considerably larger than one. Combined with the probable validity of the changes in market size with variations in the average market price, the impacts at all levels on U.S. demand for Latin American vegetables appear to be statistically significant. In contrast, U.S. demand for E.E.C. vegetables drops only slightly with a price decrease. These results are highly suspect as both the relative price and market size parameters have t statistics much smaller than one.

In the two groups of simulations of changes on product demands with variations in GDP and population levels, the

TABLE 8.6

INDICES OF U.S. PRODUCT DEMANDS WITH VARYING AVERAGE MARKET PRICES.

% of 1982 Average Market Price	Latin American Product	E.E.C. Product
50	2.235	0.915
60	1.809	0.937
70	1.513	0.955
80	1.296	0.972
90	1.130	0.987
100	1.000	1.000
110	0.895	1.012
120	0.809	1.024
130	0.738	1.034
140	0.677	1.044
150	0.625	1.053

U.S. has the second largest increase in its market demand with the first set, A, whereas it decreases in the second, group B. Recall that of the U.S.'s market demand parameters, that on population is negative and insignificant. Therefore these simulated market demands are probably underestimated. The simulation results for U.S. demands for Latin American vegetables are quite reliable as the parameters on this product demand are statistically significant. U.S. demand for Latin American vegetables increases in both sets of simulations with variations in GDP and population. The forces driving U.S. demand for Latin American vegetables are very strong, even with simulated declines in income this demand continues to grow. The parameters on the U.S. demand for E.E.C. vegetables are not statistically significant. These simulation results, therefore, are not as reliable as those for other regions. This product demand decreases with these two sets of simulations. The E.E.C. product demand decreases more in the second scenario than in the first. This probably indicates that E.E.C. vegetables are relatively lower priced than other products; with a drop in U.S. income, its demand for this product increases.

Canadian product demands with varying market demands

Canada's market demand for vegetables decreases with a decrease in the average market price and increases with an

TABLE 8.7

INDICES OF U.S. PRODUCT DEMANDS WITH VARYING GDP AND POPULATION LEVELS.

Increment N	Simulation Scenario	Latin American Product	E.E.C. Product
0	A[a]	1.000	1.000
0	B[b]	1.000	1.000
1	A	1.200	0.996
1	B	1.058	0.999
2	A	1.420	0.992
2	B	1.118	0.997
3	A	1.659	0.988
3	B	1.178	0.996
4	A	1.917	0.985
4	B	1.240	0.995
5	A	2.194	0.982
5	B	1.302	0.994
6	A	2.491	0.979
6	B	1.366	0.993
7	A	2.806	0.975
7	B	1.430	0.992
8	A	3.140	0.973
8	B	1.496	0.990
9	A	3.492	0.971
9	B	1.562	0.989
10	A	3.861	0.968
10	B	1.629	0.988

[a]A = N * (Actual Percentage) * GDP 1982,
N * (Actual Percentage) * Population 1982

[b]B = N * (3 Percent) * GDP 1982,
N * (Actual Percentage) * Population 1982

increase in this price (see Table 8.1). The changes are very small however, and the t value of the price parameter in the market demand equation was so small that these results are probably not statistically valid (see Table 6.7).

Simulations on Latin American and U.S. product demands also show a decrease with a decrease in the average market price and an increase with an increase (Table 8.8). All of the parameters in these product demand equations are statistically valid, however the lack of validity in the direct market size response makes these results on the product level suspect.

Simulations varying GDP and population levels reveal that Canada's demand for Latin American and U.S. products will continue to increase both with multiples of observed trends and with multiples of only 3 percent increases in GDP (see Table 8.9). Its demand for Latin American vegetables increases more with the smaller increases in income, probably indicating that this product is lower priced than that from the U.S., its chief competitor. All of the parameters on Canada's demand relationships, market demand and product demands for U.S. and Latin American vegetables are statistically significant. Therefore the simulation results are quite reliable.

TABLE 8.8

INDICES OF CANADIAN PRODUCT DEMANDS WITH VARYING AVERAGE MARKET PRICES.

% of 1982 Average Market Price	Latin American Product	U.S. Product
50	0.666	0.633
60	0.741	0.714
70	0.812	0.791
80	0.878	0.863
90	0.940	0.933
100	1.000	1.000
110	1.057	1.065
120	1.113	1.128
130	1.166	1.189
140	1.218	1.248
150	1.268	1.306

TABLE 8.9

INDICES OF CANADIAN PRODUCT DEMANDS WITH VARYING GDP AND POPULATION LEVELS.

Increment N	Simulation Scenario	Latin American Product	U.S. Product
0	A[a]	1.000	1.000
0	B[b]	1.000	1.000
1	A	1.005	1.013
1	B	1.009	1.026
2	A	1.010	1.028
2	B	1.019	1.054
3	A	1.016	1.045
3	B	1.029	1.082
4	A	1.022	1.063
4	B	1.039	1.112
5	A	1.029	1.082
5	B	1.049	1.143
6	A	1.035	1.102
6	B	1.060	1.175
7	A	1.043	1.124
7	B	1.070	1.209
8	A	1.050	1.147
8	B	1.081	1.243
9	A	1.058	1.171
9	B	1.092	1.279
10	A	1.066	1.196
10	B	1.103	1.316

[a]A = N * (Actual Percentage) * GDP 1982,
N * (Actual Percentage) * Population 1982

[b]B = N * (3 Percent) * GDP 1982,
N * (Actual Percentage) * Population 1982

European Economic Community product demands with varying market demands

The E.E.C.'s market demand increases with a decrease in the average market price, and vice versa (see Table 8.1). The variations are fairly substantial, reflecting the large, but still inelastic, negative price parameter on the market size equation (see Table 6.7). The t value on this parameter is larger than one, indicating that these results are probably valid.

E.E.C. demands for Latin American, U.S., Canadian, Far Eastern, African, and Non-E.E.C. Western European vegetables were simulated. All of these product demands have at least one insignificant parameter, that for Africa is insignificant for both price and market size. Therefore the simulation results at the product demand level must be regarded with some skepticism. If the simulations had been carried out without the insignificant parameters, the demand for Latin American vegetables would be larger, that for U.S. vegetables smaller, Canadian smaller, Far Eastern larger, and Non-E.E.C. Western European vegetables larger. Demands for African vegetables would not have been estimated.

In the scenarios with variations in the average market price of vegetables, only the demands for Canadian and Non-E.E.C. Western European vegetables increase with a decrease in price (see Table 8.10). All others decrease with a price decrease. Of the two products whose demands

TABLE 8.10

INDICES OF EUROPEAN ECONOMIC COMMUNITY PRODUCT DEMANDS WITH VARYING AVERAGE MARKET PRICES.

% of 1982 Average Market Price	Latin American Product	U.S. Product	Canadian Product	Far Eastern Product	African Product	Non-E.E.C W. European Product
50	0.163	0.072	21.238	0.043	0.756	3.363
60	0.262	0.144	9.507	0.099	0.814	2.445
70	0.393	0.258	4.818	0.199	0.866	1.867
80	0.557	0.429	2.674	0.364	0.914	1.478
90	0.759	0.670	1.591	0.621	0.958	1.203
100	1.000	1.000	1.000	1.000	1.000	1.000
110	1.284	1.436	0.657	1.539	1.039	0.846
120	1.612	1.998	0.448	2.282	1.076	0.727
130	1.988	2.707	0.315	3.279	1.112	0.632
140	2.414	3.586	0.227	4.585	1.145	0.555
150	2.892	4.659	0.167	6.266	1.178	0.492

increase with a price decrease, Canada and the Non-E.E.C. Western European region, that for Canada shows the most dramatic changes. With the average market price 80 percent of the 1982 level, the demand for Canada's vegetables increases more than two fold. In contrast, the demand for the Non-E.E.C. Western European region's vegetables increase by less than 50 percent with a 20 percent price decrease.

Of the three regions whose demands decrease with a price decrease and whose results have some statistical validity, Latin America, the U.S., and the Far East, that for the Far East shows the most extreme variations. Demand for this product decreases to 36 percent of its 1982 level with a price decrease of 20 percent. The demand for U.S. vegetables decreases to 43 percent, and that for Latin American vegetables to 56 percent of 1982 levels.

In the simulations with variations in GDP and population levels, the results are interesting in that for both sets of simulations, demands for all products except those from the U.S. and Canada decline (see Table 8.11). This is due to the fact that for all of these product demands, except that for Canada, there is at least one negative parameter. Thus if current trends continue and the estimated relationships are to be believed, E.E.C. demands for Latin American, Far Eastern, African, and Non-E.E.C. Western European vegetables will decline, with the largest decline seen in that for the Latin American product and the

TABLE 8.11

INDICES OF E.E.C. PRODUCT DEMANDS WITH VARYING GDP AND POPULATION LEVELS.

Increment N	Simulation Scenario	Latin American Product	U.S. Product	Canadian Product	Far Eastern Product	African Product	Non-E.E.C. W. European Product
0	A[a]	1.000	1.000	1.000	1.000	1.0000	1.0000
0	B[b]	1.000	1.000	1.000	1.000	1.0000	1.0000
1	A	0.946	1.007	1.014	0.986	0.9999	0.9976
1	B	0.977	1.003	1.006	0.994	0.9999	0.9990
2	A	0.898	1.013	1.027	0.973	0.9999	0.9954
2	B	0.955	1.006	1.012	0.988	0.9999	0.9980
3	A	0.855	1.019	1.040	0.960	0.9998	0.9933
3	B	0.934	1.008	1.017	0.982	0.9999	0.9970
4	A	0.818	1.025	1.053	0.949	0.9998	0.9913
4	B	0.913	1.011	1.023	0.977	0.9999	0.9961
5	A	0.783	1.030	1.063	0.939	0.9997	0.9895
5	B	0.894	1.014	1.029	0.971	0.9999	0.9952
6	A	0.753	1.035	1.074	0.929	0.9997	0.9878
6	B	0.875	1.016	1.034	0.966	0.9998	0.9943
7	A	0.724	1.040	1.084	0.920	0.9996	0.9862
7	B	0.857	1.019	1.039	0.961	0.9998	0.9934
8	A	0.698	1.045	1.094	0.911	0.9996	0.9846
8	B	0.840	1.021	1.044	0.956	0.9998	0.9925
9	A	0.674	1.049	1.104	0.903	0.9996	0.9831
9	B	0.823	1.024	1.050	0.951	0.9998	0.9916
10	A	0.652	1.053	1.113	0.895	0.9995	0.9817
10	B	0.807	1.026	1.055	0.946	0.9997	0.9908

[a]A = N * (Actual Percentage) * GDP 1982, N * (Actual Percentage) * Population 1982

[b]B = N * (3 Percent) * GDP 1982, N * (Actual Percentage) * Population 1982

smallest for the African product. Demands for U.S. and Canadian vegetables will grow moderately. If GDP only grows in multiples of 3 percent, the same pattern will occur, at lower levels of demand.

Middle Eastern product demands with varying market demands

Middle Eastern market demands vary more than do those of any of the other regions with variations in the average market price of vegetables (see Table 8.1). These results are suspect, however, as the price parameter on the market demand equation has a t value considerably less than 1 (see Table 6.7). It is important to keep in mind that, while its participation in fresh vegetable trade is growing, the Middle East is still a relatively small market. Consequently, small quantity changes could lead to large percentage changes in its market demand and the large indices of Table 8.1.

Middle Eastern demands for U.S., E.E.C., African, and Non-E.E.C. Western European vegetables were simulated. Of these, the demands for U.S. and E.E.C. vegetables increase with a decrease in the average market price while those for African and Non-E.E.C. Western European vegetables decrease (see Table 8.12). All of the parameters on these product demands equations are statistically valid (see Table 6.8). The only exception is that for U.S. vegetables corresponding to market size. The results at the product level are

TABLE 8.12

INDICES OF MIDDLE EASTERN PRODUCT DEMANDS WITH VARYING AVERAGE MARKET PRICES.

% of 1982 Average Market Price	U.S. Product	E.E.C. Product	African Product	Non-E.E.C. W. European Product
50	1.055	2.127	0.520	0.559
60	1.040	1.744	0.617	0.651
70	1.028	1.475	0.714	0.741
80	1.017	1.275	0.810	0.829
90	1.008	1.122	0.905	0.915
100	1.000	1.000	1.000	1.000
110	0.993	0.901	1.094	1.083
120	0.986	0.820	1.188	1.166
130	0.980	0.752	1.281	1.247
140	0.974	0.693	1.374	1.327
150	0.969	0.643	1.467	1.406

therefore probably valid except for the fact that the impacts at the market demand level are statistically insignificant.

Of the two product demands which show a negative relationship to changes in the average market price, the U.S. and the E.E.C., that for the E.E.C. shows the largest variation. It increases by almost 30 percent of its 1982 level with a price decrease of 20 percent. There is very little variation in demand for U.S. vegetables; its demand increases by less than 2 percent with a price decrease of 20 percent.

Simulations on market demands show the Middle East to have the strongest responses of all eight regions to changes in GDP and population (see Table 8.13). Its product demands also show strong responses. The Middle East's demand for U.S., E.E.C., African, and Non-E.E.C. Western European vegetables were simulated. All grow substantially with continuation of current trends, simulation A; all decline substantially with GDP changes in multiples of 3 percent, simulation B (see Table 8.8). The reasons for this result lie in its market demand parameters. That for GDP is of moderate size at 3.119 but that for population is very large and negative at -9.481 (see Table 6.7). If growth in GDP is simulated at the observed growth rate of 30 percent, its moderately large, positive parameter overcomes the very large negative parameter on population, which grew at a rate

TABLE 8.13

INDICES OF MIDDLE EASTERN PRODUCT DEMANDS WITH VARYING GDP AND POPULATION LEVELS.

Increment N	Simulation Scenario	U.S. Product	E.E.C. Product	African Product	Non-E.E.C. W. European Product
0	A[a]	1.000	1.000	1.000	1.000
0	B[b]	1.000	1.000	1.000	1.000
1	A	1.785	2.645	1.588	1.488
1	B	0.817	0.712	0.851	0.870
2	A	2.675	5.215	2.194	1.964
2	B	0.671	0.512	0.727	0.760
3	A	3.583	8.519	2.770	2.400
3	B	0.554	0.371	0.624	0.667
4	A	3.443	12.226	3.290	2.782
4	B	0.460	0.272	0.538	0.587
5	A	5.211	15.980	3.737	3.104
5	B	0.384	0.200	0.465	0.518
6	A	5.863	19.472	4.105	3.365
6	B	0.322	0.149	0.404	0.459
7	A	6.386	22.479	4.395	3.569
7	B	0.271	0.112	0.352	0.408
8	A	6.783	24.871	4.612	3.719
8	B	0.229	0.084	0.308	0.364
9	A	7.059	26.596	0.761	3.823
9	B	0.194	0.064	0.270	0.325
10	A	7.227	27.665	4.851	3.885
10	B	0.166	0.049	0.238	0.291

[a]A = N * (Actual Percentage) * GDP 1982,
N * (Actual Percentage) * Population 1982

[b]B = N * (3 Percent) * GDP 1982,
N * (Actual Percentage) * Population 1982

of 3 percent. However, if GDP is only simulated to grow by 3 percent, the population parameter overcomes that on GDP, causing demand to fall.

The strongest growth and decline is seen in the Middle East's simulated demand for E.E.C. vegetables, the weakest in Non-E.E.C. Western European vegetables. The Middle East's demand for U.S. vegetables will increase substantially if current trends continue. But if this region sees a sharp drop in income, perhaps due to falling oil revenues, this demand will fall drastically.

Far Eastern product demands with varying market demands

Far Eastern market demands decrease slightly with decreases in the average market price and increase with increases. This is a reflection of the positive, inelastic price parameter on the market demand equation (see Table 6.7). These results are statistically valid, with the limited interpretation possible in a nonlinear simultaneous system, as the t value on this parameter is considerably larger than one.

Product demands for U.S., E.E.C., Middle Eastern, and Non-E.E.C. Western European vegetables were simulated. All show a positive response to changes in the average market price. With price decreases, product demands decrease and vice versa (see Table 8.14). Of these four product demands, all have at least one statistically significant parameter, thus the simulation results are valid to some degree.

TABLE 8.14

INDICES OF FAR EASTERN PRODUCT DEMANDS WITH VARYING AVERAGE MARKET PRICES.

% of 1982 Average Market Price	U.S. Product	E.E.C. Product	Middle Eastern Product	Non-E.E.C. W. European Product
50	0.995	0.262	0.183	0.510
60	0.996	0.373	0.286	0.609
70	0.998	0.502	0.417	0.707
80	0.998	0.650	0.579	0.805
90	0.999	0.816	0.772	0.903
100	1.000	1.000	1.000	1.000
110	1.001	1.202	1.263	1.097
120	1.001	1.422	1.564	1.194
130	1.002	1.660	1.903	1.291
140	1.002	1.916	2.282	1.387
150	1.003	2.189	2.703	1.483

The largest variation is seen in the Middle Eastern product demand, which decreases to 58 percent of its 1982 level with a price decrease of 20 percent. The E.E.C. shows the next largest variation, followed by the Non-E.E.C. Western European region. There is very little variation in the demand for U.S. vegetables.

All of these product demands show increases for both sets of simulations, larger for the second set, except for those for the Middle East (see Table 8.15). Whether the Far East's GDP grows in multiples of 20 percent, as shown by the data, or in multiples of 3 percent, its demand for Middle Eastern vegetables will drop if the simulation results are to be believed.

The Far Eastern market size parameters are all statistically significant except that on GDP, which is insignificant. As regards the product demand parameters, that for Middle Eastern vegetables on market size is insignificant and that for price on Non-E.E.C. Western European vegetables is insignificant. If market size were not included in the simulation of Far Eastern demand for Middle Eastern vegetables, as estimation results indicate would be appropriate, then the simulated demand would be larger. If price were not included in the simulation of the demand for Non-E.E.C. Western European vegetables, this demand would not change a great deal. Both of the product demand parameters for U.S. vegetables are significant and thus the simulation results for this product are reliable.

TABLE 8.15

INDICES OF FAR EASTERN PRODUCT DEMANDS WITH VARYING GDP AND POPULATION LEVELS.

Increment N	Simulation Scenario	U.S. Product	E.E.C. Product	Middle Eastern Product	Non-E.E.C. W. European Product
0	A[a]	1.000	1.000	1.000	1.000
0	B[b]	1.000	1.000	1.000	1.000
1	A	1.133	1.091	0.945	1.133
1	B	1.152	1.103	0.938	1.152
2	A	1.280	1.187	0.894	1.281
2	B	1.319	1.213	0.882	1.321
3	A	1.442	1.290	0.847	1.445
3	B	1.503	1.328	0.831	1.506
4	A	1.620	1.399	0.804	1.624
4	B	1.705	1.450	0.785	1.710
5	A	1.814	1.514	0.764	1.820
5	B	1.926	1.579	0.743	1.933
6	A	2.025	1.635	0.726	2.033
6	B	2.167	1.714	0.705	2.176
7	A	2.255	1.762	0.692	2.265
7	B	2.429	1.855	0.669	2.441
8	A	2.503	1.895	0.660	2.516
8	B	2.713	2.000	0.636	2.728
9	A	2.772	2.034	0.630	2.787
9	B	3.020	2.160	0.606	3.038
10	A	3.060	2.180	0.603	3.079
10	B	3.351	2.322	0.578	3.373

[a]A = N * (Actual Percentage) * GDP 1982,
N * (Actual Percentage) * Population 1982

[b]B = N * (3 Percent) * GDP 1982,
N * (Actual Percentage) * Population 1982

African product demands with varying market demands

The African market demand shows a positive relationship with the average market price (see Table 8.1). The variations in this market demand are very small with variations in this price. This reflects the very small, positive price parameter on this equation (see Table 6.7). The price parameter is, however, statistically insignificant. Therefore the set of simulations where market demands are projected for changing levels of average market prices is probably invalid.

African demands for U.S., E.E.C., Middle Eastern, and Far Eastern vegetables were simulated. Of these product demands, all have at least one statistically significant parameter. Therefore the simulation results are all somewhat valid. They are, however, compromised by the insignificant market demand simulation.

Of these product demand simulations, only the demand for Middle Eastern vegetables increases with a decrease in the average market price (see Table 8.16). Its variation is quite small, with a 20 percent decrease in price, there is less than a 10 percent increase in demand. The U.S., E.E.C., and Far East all show positive responses to changes in the average market price. The largest variation is seen in the demand for U.S. vegetables, with a 20 percent drop in price, this demand decreases to 56 percent of the base

TABLE 8.16

INDICES OF AFRICAN PRODUCT DEMANDS WITH VARYING AVERAGE MARKET PRICES.

% of 1982 Average Market Price	U.S. Product	E.E.C. Product	Middle Eastern Product	Far Eastern Product
50	0.164	0.335	1.259	0.403
60	0.264	0.447	1.185	0.512
70	0.395	0.570	1.126	0.626
80	0.559	0.704	1.077	0.746
90	0.760	0.847	1.036	0.871
100	1.000	1.000	1.000	1.000
110	1.282	1.162	0.969	1.133
120	1.609	1.333	0.941	1.270
130	1.982	1.512	0.917	1.411
140	2.405	1.700	0.894	1.555
150	2.879	1.895	0.874	1.702

level. This is followed by the E.E.C., with a 30 percent drop in demand, and the Far East with a 26 percent drop.

In the two sets of simulations with variations GDP and population levels, all of these product demands show substantial increases, with the second set, with 3 percent increases in GDPs, being the larger (see Table 8.17). This reflects the negative parameter on GDP in Africa's market demand equation. This parameter is statistically insignificant, which indicates that the null hypothesis that GDP does not affect market demand cannot be rejected. The simulations would have been more reliable if GDP had not been included for Africa.

The product demand simulations indicate that Africa's demand for Middle Eastern vegetables will increase substantially whether current trends continue or if its GDP increases by only 3 percent. This will be followed by its demand for U.S., Far Eastern, and lastly, E.E.C. vegetables. All of the product demand parameters associated with the vegetables from these regions are statistically significant. Therefore the simulation results are reliable except for the fact that market size would be larger if GDP had not been included.

The Non-E.E.C. Western European product demands with varying market demands

Simulations for the Non-E.E.C. Western European region varying the average export price of vegetables show little

TABLE 8.17

INDICES OF AFRICAN PRODUCT DEMANDS WITH VARYING GDP AND POPULATION LEVELS.

Increment N	Simulation Scenario	U.S. Product	E.E.C. Product	Middle Eastern Product	Far Eastern Product
0	A[a]	1.000	1.000	1.000	1.000
0	B[b]	1.000	1.000	1.000	1.000
1	A	1.092	1.059	1.188	1.078
1	B	1.112	1.071	1.232	1.095
2	A	1.192	1.121	1.412	1.162
2	B	1.233	1.146	1.509	1.196
3	A	1.301	1.186	1.677	1.252
3	B	1.363	1.223	1.838	1.302
4	A	1.419	1.255	1.989	1.348
4	B	1.503	1.303	2.226	1.416
5	A	1.545	1.326	2.351	1.449
5	B	1.623	1.386	2.683	1.535
6	A	1.681	1.401	2.773	1.557
6	B	1.813	1.471	3.217	1.661
7	A	1.826	1.478	3.262	1.671
7	B	1.985	1.560	3.842	1.794
8	A	1.981	1.558	3.827	1.791
8	B	2.167	1.652	4.567	1.934
9	A	2.145	1.641	4.476	1.917
9	B	2.362	1.747	5.406	2.081
10	A	2.320	1.727	5.221	2.050
10	B	2.569	1.845	6.375	2.236

[a]A = N * (Actual Percentage) * GDP, 1982,
N * (Actual Percentage) * Population 1982

[b]B = N * (3 Percent) * GDP 1982,
N * (Actual Percentage) * Population 1982

change in the market demands (see Table 8.1). This is due to the highly inelastic price parameter on the market demand equation. This parameter is statistically significant (see Table 6.7).

Six of this region's product demands were simulated with varying average export prices. These were for U.S., Canadian, E.E.C., Middle Eastern, Far Eastern, and African vegetables. At least one of the parameters on each of these equations is statistically significant. Combined with the significant market demand parameter for price, this lends credibility to the product demand simulation.

Demands for Canadian and E.E.C. vegetables increase with a decrease in the average export price, the other four decrease with a decrease (see Table 8.18). The market size parameters on the Non-E.E.C. Western European region's demands for U.S., Canadian, and E.E.C. vegetables are insignificant. Therefore the simulations of the product demands for the U.S. and Canada would have been smaller and that for the Non-E.E.C. Western Europe larger, if market size had not been included. The demand for Canadian vegetables increases by almost 50 percent with a price decrease of 10 percent, the demand for U.S. vegetables decreases by more than 40 percent, and that for E.E.C. vegetables increases by more than 30 percent. These three demands have the most extreme responses to the simulation varying the average market price. Those for African, Middle Eastern, and Far Eastern vegetables are more moderate.

TABLE 8.18

INDICES OF NON-E.E.C. PRODUCT DEMANDS WITH VARYING AVERAGE MARKET PRICES.

% of 1982 Average Market Price	U.S. Product	Canadian Product	E.E.C. Product	Middle Eastern Product	Far Eastern Product	African Product
50	0.028	13.416	6.462	0.120	0.524	0.060
60	0.071	6.777	3.956	0.209	0.621	0.126
70	0.158	3.804	2.612	0.335	0.717	0.235
80	0.315	2.307	1.823	0.505	0.812	0.404
90	0.580	1.484	1.328	0.724	0.907	0.652
100	1.000	1.000	1.000	1.000	1.000	1.000
110	1.638	0.700	0.774	1.339	1.093	1.473
120	2.569	0.505	0.612	1.748	1.185	2.097
130	3.888	0.374	0.494	2.233	1.277	2.903
140	5.705	0.284	0.404	2.802	1.368	3.923
150	8.153	0.219	0.336	3.462	1.459	5.191

For the two sets of simulations with variations in GDP and population levels, the demands for E.E.C. and Far Eastern vegetables decline while those for the other regions increase (see Table 8.19). The simulation results indicate that if current trends continue, simulation group A, or if GDP increases by only 3 percent, simulation group B, the Non-E.E.C. Western European region's demand for E.E.C. and Far Eastern vegetables will decline, that for E.E.C. only very slightly, while that for the Far East will decline more rapidly. The demand for African vegetables will increase, followed by that for the Middle East, the U.S., and Canada, none of which will increase by a large percentage.

The market demand parameter on GDP is insignificant and positive for the Non-E.E.C. Western European region. If the simulations had not allowed GDP levels to have any impact, as estimation results indicate would have been appropriate, simulated market demands for the Non-E.E.C. Western European region would have been somewhat smaller. There also would have been no difference whatsoever between simulations of current trends and simulations with GDP increasing by only 3 percent.

Simulations Varying Product Prices

In this simulation the selected product demands were simulated with the product prices varied from 50 to 150

TABLE 8.19

INDICES OF NON-E.E.C. EUROPEAN PRODUCT DEMANDS WITH VARYING GDP AND POPULATION LEVELS.

Increment N	Simulation Scenario	U.S. Product	Canadian Product	E.E.C. Product	Middle Eastern Product	Far Eastern Product	African Product
0	A[a]	1.000	1.000	1.000	1.000	1.000	1.000
0	B[b]	1.000	1.000	1.000	1.000	1.000	1.000
1	A	1.021	1.005	0.999	1.051	0.903	1.087
1	B	1.010	1.002	0.999	1.024	0.952	1.041
2	A	1.040	1.009	0.997	1.099	0.824	1.173
2	B	1.020	1.005	0.999	1.049	0.907	1.084
3	A	1.057	1.013	0.996	1.146	0.757	1.258
3	B	1.030	1.007	0.998	1.074	0.864	1.128
4	A	1.074	1.017	0.995	1.191	0.700	1.342
4	B	1.040	1.009	0.997	1.100	0.824	1.174
5	A	1.090	1.020	0.994	1.235	0.650	1.427
5	B	1.050	1.011	0.997	1.125	0.786	1.220
6	A	1.106	1.024	0.993	1.278	0.605	1.513
6	B	1.060	1.013	0.996	1.151	0.750	1.269
7	A	1.121	1.027	0.992	1.321	0.566	1.600
7	B	1.070	1.016	0.995	1.178	0.716	1.318
8	A	1.136	1.030	0.991	1.364	0.530	1.689
8	B	1.079	1.018	0.995	1.205	0.683	1.369
9	A	1.150	1.033	0.990	1.407	0.498	1.779
9	B	1.089	1.020	0.994	1.232	0.653	1.422
10	A	1.164	1.036	0.990	1.449	0.468	1.871
10	B	1.099	1.022	0.993	1.260	0.624	1.476

[a]A = N * (Actual Percentage) * GDP 1982, N * (Actual Percentage) * Population 1982

[b]B = N * (3 Percent) * GDP 1982, N * (Actual Percentage) * Population 1982

percent of their 1982 levels. Exchange rate fluctuations, changes in tariffs or non-tariff barriers could cause product prices to vary by these amounts. This set of scenarios yields useful information to policy makers attempting to understand the impacts of current monetary and trade policies of their own governments and those of their trading partners. It could also help them to formulate new policies in these realms designed to maximize the gain to their countries from participation in fresh vegetable trade.

Latin American product demands with varying product prices

Tariffs are not a major aspect of Latin American policy regarding imports of fresh vegetable products. Exchange rate fluctuations would be the cause of major changes in the prices of vegetable products. The exchange rates of Latin American currencies fluctuate a great deal and are a factor of considerable importance in Latin American participation in international trade.

Table 8.20 presents the results of the variations of the product prices of Canadian, E.E.C., and Non-E.E.C. Western European vegetables to Latin America. Note that because of the positive price parameters on Canadian and E.E.C. vegetables, with prices below the 1982 levels, Latin American demand for these products drops (see Table 6.8). Obviously the positive sign is incorrect for these price effects and reflects either data or modelling problems as

TABLE 8.20

INDICES OF LATIN AMERICAN PRODUCT DEMANDS WITH VARYING PRODUCT PRICES.

% of 1982 Product Price	Canadian Product	E.E.C. Product	Non-E.E.C. W. European Product
50	0.285	0.716	2.255
60	0.397	0.782	1.821
70	0.524	0.842	1.520
80	0.668	0.898	1.299
90	0.826	0.951	1.312
100	1.000	1.000	1.000
110	1.188	1.047	0.894
120	1.391	1.092	0.807
130	1.608	1.135	0.735
140	1.839	1.176	0.674
150	2.083	1.215	0.622

discussed in Chapter VI. The simulation results cannot be accepted as valid for these product demands.

The price parameter on Non-E.E.C. Western European vegetables is negative and has a t value greater than one. The simulations indicate that with product price decreases , demand increases quite a bit. It can be concluded that if and when Latin American currencies gain strength, this region's demand for Non-E.E.C. Western European vegetables will grow, whether or not the size of the Latin American market grows.

United States product demands with varying product prices

The United States is a trader of some importance in the international flow of fresh vegetables. Both exchange rate fluctuations and tariff and non-tariff barriers are strong factors in its levels and directions of participation.

Table 8.21 presents the results of simulations on the prices of Latin American and E.E.C. vegetables to the U.S. Those regarding Latin America are plausible as this product's price parameter is statistically significant (see Table 6.8). However, the simulations regarding the U.S.'s demand for E.E.C. vegetables are, at best, suspect as the price parameter on this product is statistically insignificant. Empirical results seem to indicate that trade agreements, not price, govern U.S. imports of E.E.C. vegetables.

TABLE 8.21

INDICES OF U.S. PRODUCT DEMANDS WITH VARYING PRODUCT PRICES.

% of 1982 Product Price	Latin American Product	E.E.C. Product
50	1.537	1.061
60	1.373	1.045
70	1.248	1.031
80	1.148	1.019
90	1.068	1.009
100	1.000	1.000
110	0.943	0.992
120	0.893	0.984
130	0.850	0.978
140	0.812	0.971
150	0.778	0.966

U.S. demand for Latin American vegetables increases with a decrease in the price of that product, whether or not the size of the U.S. market increases. Given the weakness of Latin American currencies, it seems likely that the price of this product to the U.S. will drop. In that case, demand will increase.

Canadian product demands with varying product prices

Canada does impose tariffs on the import of fresh vegetables, a level of about 13 percent has been the average for several years. Its currency does not fluctuate greatly. Price changes for vegetable products to Canada, therefore, would most likely be a result of market forces or policy changes regarding tariff and non-tariff barriers.

Canadian demands for Latin American and U.S. vegetables were simulated with prices ranging from 50 to 150 percent of the 1982 level (see Table 8.22). The indices of changes in the demands for these two products were very close; a reflection of the fact that the price elasticities of demand are almost identical. They are also both negative and statistically significant. The demand changes were not extreme but they were substantial, particularly given the fact that Canada is a major market for both Latin America and the U.S. Canadian demand for both Latin American and U.S. vegetables would increase if the tariffs on these products were lowered.

TABLE 8.22

INDICES OF CANADIAN PRODUCT DEMANDS WITH VARYING PRODUCT PRICES.

% of 1982 Product Price	Latin American Product	U.S. Product
50	1.451	1.437
60	1.316	1.306
70	1.211	1.205
80	1.127	1.124
90	1.058	1.057
100	1.000	1.000
110	0.950	0.951
120	0.907	0.909
130	0.869	0.872
140	0.835	0.839
150	0.804	0.809

<u>European Economic Community product demands with varying product prices</u>

The E.E.C. is one of the largest markets for fresh vegetables. The CAP, with its variable levy, is a major barrier for many products. The simulations give some indication of what the results would be if the tariffs imposed by the CAP were both decreased, leading to lower prices for imported products, and increased, leading to higher prices. Simulations were conducted for Latin America, U.S., Canadian, Far Eastern, Africa, and Non-E.E.C. Western European vegetables. Of these, the price parameters are significant with the exception of those for Latin American and African vegetables (see Table 6.8). The simulations for these two products can be disregarded as their price parameters are statistically insignificant.

The most striking results were for the U.S. and the Far East (see Table 8.23). With prices 80 percent of the 1982 level, E.E.C. demand for U.S. vegetables is almost two and a half times its 1982 level, that for Far Eastern vegetables almost two and a half times its 1982 level. These results indicate the tremendous impact the CAP has on trade in fresh vegetables with the E.E.C. A lowering of tariffs on U.S. vegetables would result in large increases in E.E.C. demand for U.S. vegetables and expand U.S. export potential. The results also demonstrate the strong price sensitivity in the E.E.C. to Far Eastern vegetables.

TABLE 8.23

INDICES OF E.E.C. PRODUCT DEMANDS WITH VARYING PRODUCT PRICES.

% of 1982 Product Price	Latin American Product	U.S. Product	Canadian Product	Far Eastern Product	African Product	Non-E.E.C. W. European Product
50	1.214	16.901	0.071	15.147	1.320	0.277
60	1.154	8.034	0.142	7.411	1.227	0.388
70	1.105	4.284	0.256	4.049	1.153	0.517
80	1.064	2.485	0.426	2.399	1.093	0.662
90	1.030	1.537	0.668	1.512	1.043	0.823
100	1.000	1.000	1.000	1.000	1.000	1.000
110	0.974	0.678	1.440	0.688	0.963	1.193
120	0.950	0.475	2.008	0.489	0.930	1.401
130	0.929	0.343	2.727	0.358	0.900	1.625
140	0.910	0.254	3.619	0.267	0.874	1.864
150	0.893	0.191	4.712	0.204	0.850	2.118

Middle Eastern product demands with varying product prices

While some of the nations included in the Middle Eastern region use tariff barriers to control their imports of fresh vegetables, for the region as a whole, tariffs are not a major factor in imports of this commodity. Also, the exchange rates of the currencies of the Middle East did not fluctuate greatly in the years 1962 to 1982, nor does it seem likely that they will in the near future. Therefore market forces, including transportation costs, are the factors leading to changes in the prices of vegetable products in the Middle East.

Simulations were carried out varying the prices of U.S., E.E.C., Far Eastern, and Non-E.E.C. Western European vegetables. The price parameter on Middle Eastern demands for each of these products are statistically significant, therefore each of the simulations are plausible (see Table 6.8).

Middle Eastern demand for each of these four products fluctuates greatly with changes in the product prices (see Table 8.24). Demand for fresh vegetable products in the Middle East is highly sensitive to price. The greatest changes are observed in demand for Far Eastern vegetables, followed by Non-E.E.C. Western European vegetables, E.E.C., and lastly, U.S. vegetables. These simulations demonstrate that in order for the U.S. to increase its share of the Middle Eastern market, it will have to acquire some

TABLE 8.24

INDICES OF MIDDLE EASTERN PRODUCT DEMANDS WITH VARYING PRODUCT PRICES.

% of 1982 Product Price	U.S. Product	E.E.C. Product	African Product	Non-E.E.C. W. European Product
50	3.583	4.380	5.564	4.457
60	2.561	2.970	3.542	3.008
70	1.928	2.138	2.418	2.158
80	1.508	1.609	1.738	1.618
90	1.214	1.252	1.298	1.255
100	1.000	1.000	1.000	1.000
110	0.839	0.816	0.790	0.814
120	0.715	0.678	0.637	0.675
130	0.617	0.572	0.522	0.568
140	0.538	0.488	0.435	0.484
150	0.474	0.421	0.366	0.417

advantage other than price, although demand for U.S. vegetables did increase substantially with the lower prices. Technological improvements lowering the transportation costs of fresh vegetables would greatly increase the Middle East's demand for all four of these products.

Far Eastern product demands with varying product prices

The Far East uses mainly non-tariff barriers to impede the flow of fresh vegetables into its market. All of these policies result in increased product prices to this region. The exchange rates of the Far Eastern currencies with respect to the U.S. dollar remained fairly constant from 1962 to 1982. Therefore the simulations regarding price changes would most likely be caused by a change in policies regarding non-tariff barriers.

Simulations were carried out on Far Eastern demands for U.S., E.E.C., Middle Eastern, and Non-E.E.C. Western European vegetables. The price parameter on the Non-E.E.C. Western European region is statistically insignificant, therefore the simulations regarding demand for this product are suspect (see Table 6.8). The other price elasticities are statistically significant and their simulations quite plausible.

The results show the greatest change in Far Eastern demand for Middle Eastern vegetables with price variations (see Table 8.25). The Middle East, therefore, would benefit

TABLE 8.25

INDICES OF FAR EASTERN PRODUCT DEMANDS WITH VARYING PRODUCT PRICES.

% of 1982 Product Price	U.S. Product	E.E.C. Product	Middle Eastern Product	Non-E.E.C. W. European Product
50	0.516	2.398	7.402	1.003
60	0.614	1.905	4.372	1.003
70	0.711	1.569	2.801	1.002
80	0.808	1.325	1.905	1.001
90	0.904	1.142	1.356	1.001
100	1.000	1.000	1.000	1.000
110	1.095	0.887	0.759	1.000
120	1.190	0.794	0.591	0.999
130	1.285	0.718	0.469	0.999
140	1.379	0.654	0.378	0.998
150	1.473	0.599	0.310	0.998

a great deal by the Far East lowering its barriers on fresh vegetable imports. Demand for E.E.C. vegetables would also increase significantly with a lowering of these barriers. U.S. vegetables, on the other hand, have a positive price relationship with respect to Far Eastern demand. This most likely reflects problems with the model or data and does not indicate an upward sloping demand function.

African product demands with varying product prices

In general, African tariffs on fresh vegetable imports are negligible. African currencies remained fairly constant with respect to the U.S. dollar from 1962 to 1982. A general conclusion can be made that market forces govern imported vegetable product prices in Africa. These market forces include the costs of transportation.

Simulations were carried out on African demands for U.S., E.E.C., Middle Eastern, and Far Eastern vegetables with varying prices. All of the price parameters on these products are statistically significant and therefore the simulations are all plausible (see Table 6.8).

The demands for U.S. vegetables show the greatest variations (see Table 8.26). With lowered prices, African demand for U.S. vegetables increases rather dramatically. These results verify conclusions reached in Chapter VII. If the U.S. can lower the costs of transporting vegetables, it can expand its sales in Africa.

TABLE 8.26

INDICES OF AFRICAN PRODUCT DEMANDS WITH VARYING PRODUCT PRICES.

% of 1982 Product Price	U.S. Product	E.E.C. Product	Middle Eastern Product	Far Eastern Product
50	5.926	2.928	0.752	2.423
60	3.711	2.207	0.810	1.920
70	2.498	1.738	0.863	1.567
80	1.773	1.413	0.912	1.330
90	1.311	1.177	0.958	1.144
100	1.000	1.000	1.000	1.000
110	0.783	0.863	1.040	0.885
120	0.626	0.754	1.078	0.792
130	0.510	0.666	1.144	0.715
140	0.422	0.594	1.149	0.651
150	0.353	0.533	1.182	0.596

After the U.S., the demands for E.E.C. and Non-E.E.C. Western European vegetables also increase. As technology improves, lowering the costs of transporting fresh vegetables, Africa will demand more U.S., E.E.C., and Non-E.E.C. Western European fresh vegetables. African demand for Middle Eastern vegetables shows a positive price relationship, with price decreases, demand decreases, and vice versa. This result must be wrong and reflects either modelling or data problems.

<u>Non-E.E.C. Western European product demands with varying product prices</u>

The Non-E.E.C. Western European region imposes tariffs on fresh vegetables, but not to such an extent that its market is artificially manipulated, as is the case in the E.E.C., and the U.S. and the Far East by non-tariff barriers, to some extent. The Non-E.E.C. Western European region charges the same moderate tariff on all vegetable products.

Simulations were carried out on demands for U.S., Canadian, E.E.C., Middle Eastern, Far Eastern, and African vegetables. Of these, all except the Far East have statistically significant price parameters and thus their simulations are plausible (see Table 6.8). Results indicate that Non-E.E.C. Western European demand for U.S., African, and Middle Eastern vegetables will grow tremendously with lower prices (see Table 8.27). Conversely, higher prices

TABLE 8.27

INDICES OF NON-E.E.C. W. EUROPEAN PRODUCT DEMANDS WITH VARYING PRODUCT PRICES.

% of 1982 Product Price	U.S. Product	Canadian Product	E.E.C. Product	Middle Eastern Product	Far Eastern Product	African Product
50	40.729	0.077	0.153	11.189	1.050	27.341
60	15.362	0.151	0.251	5.928	1.036	11.452
70	6.736	0.267	0.381	3.465	1.025	5.487
80	3.298	0.437	0.547	2.176	1.016	2.901
90	1.757	0.677	0.752	1.444	1.007	1.654
100	1.000	1.000	1.000	1.000	1.000	1.000
110	0.601	1.424	1.294	0.717	0.993	0.635
120	0.377	1.965	1.637	0.530	0.987	0.419
130	0.246	2.644	2.033	0.401	0.982	0.286
140	0.165	3.480	2.484	0.310	0.977	0.201
150	0.114	4.494	2.993	0.244	0.972	0.144

will decrease demand for these products. The U.S., Africa, and the Middle East would benefit from either a lowering of the tariffs on their products or a decrease in transportation costs, or both. The price effects were wrong for Canada and the E.E.C.

CIF Import Prices

The CIF import price equations link the CIF import prices to the FOB export product prices and transport costs. The functional nature of this relationship is specifically represented by (4.21), or to repeat,

$$(8.3)\ \log C(ij) = \log \Phi(0ij) + \Phi(1ij) \log F(ij) + \Phi(2ij) \log \text{Year}$$

The relationship between the CIF price and year is a proxy for that between the CIF price and transportation and handling costs. Scenarios were constructed whereby year was varied and the impacts on CIF prices measured. These simulate increases in transport and handling costs, a key factor in fresh vegetable trade.

It is important to note that the parameters for this functional relationship were estimated using data from 1962 through 1982. During this time period, oil price increases caused the costs of transport and handling to increase dramatically. The parameter on year reflects this phenomenon. However, currently oil prices are not rising

and have actually declined over the last few years. Therefore simulations using the parameters based on rising oil costs do not reflect the current situation and their usefulness is limited.

This set of simulations was completed on the same products as were the simulations on product demands. In terms of world vegetable trade, these selected pathways of trade appear to be the most significant either in size or in potential. Therefore it is important to ascertain the potential impacts resulting from changes in key relationships.

The results are presented in Tables 8.28 through 8.35. It is noteworthy that the CIF price ratios are greater than one for all trade patterns considered except for the E.E.C.'s CIF prices for Far Eastern and Non-E.E.C. Western European vegetables, and the Non-E.E.C. Western European region's CIF price for E.E.C. vegetables. That is, the CIF product prices all rise with increases in transportation and handling costs in all cases with a significant parameter on year with the exception of these three. In these three cases there is a statistically significant, negative relationship between the CIF price and transport and handling costs. It is possible that agreements exist between these regions to offset increased transportation costs which are not accounted for in the functional relationships and thus show up as these apparent negative

TABLE 8.28

INDICES OF LATIN AMERICAN CIF PRODUCT PRICES WITH VARYING YEARS.

Year = 1982 + I	Canadian Product	E.E.C. Product	Non-E.E.C. W. European Product
I = 0	1.000	1.000	1.000
I = 1	1.061	0.999	1.036
I = 2	1.194	0.998	1.113
I = 3	1.425	0.997	1.238
I = 4	1.804	0.995	1.426
I = 5	2.420	0.992	1.702
I = 6	3.439	0.989	2.104
I = 7	5.177	0.985	2.691
I = 8	8.246	0.981	3.562
I = 9	13.891	0.976	4.876
I = 10	24.729	0.971	6.901

TABLE 8.29

INDICES OF U.S. CIF PRODUCT PRICES WITH VARYING YEARS.

Year = 1982 + I	Latin American Product	E.E.C. Product
I = 0	1.000	1.000
I = 1	1.088	1.007
I = 2	1.287	1.021
I = 3	1.656	1.041
I = 4	2.315	1.070
I = 5	3.517	1.106
I = 6	5.800	1.152
I = 7	10.379	1.207
I = 8	20.133	1.273
I = 9	42.291	1.351
I = 10	96.102	1.444

TABLE 8.30

INDICES OF CANADIAN CIF PRODUCT PRICES WITH VARYING YEARS.

Year = 1982 + I	Latin American Product	U.S. Product
I = 0	1.000	1.000
I = 1	1.104	1.031
I = 2	1.347	1.096
I = 3	1.813	1.202
I = 4	2.694	1.359
I = 5	4.413	1.583
I = 6	7.966	1.900
I = 7	15.832	2.349
I = 8	34.609	2.992
I = 9	83.118	3.923
I = 10	219.031	5.293

TABLE 8.31

INDICES OF E.E.C. CIF PRODUCT PRICES WITH VARYING YEARS.

Year = 1982 + I	Latin American Product	U.S. Product	Canadian Product	Far Eastern Product	African Product	Non-E.E.C. W. European Product
I = 0	1.000	1.000	1.000	1.000	1.000	1.000
I = 1	0.998	1.033	0.991	0.959	1.007	0.969
I = 2	0.993	1.103	0.972	0.881	1.020	0.911
I = 3	0.986	1.217	0.945	0.776	1.040	0.830
I = 4	0.976	1.388	0.910	0.656	1.067	0.733
I = 5	0.964	1.633	0.868	0.531	1.102	0.628
I = 6	0.950	1.986	0.821	0.413	1.146	0.522
I = 7	0.935	2.492	0.769	0.308	1.199	0.421
I = 8	0.917	3.227	0.714	0.221	1.262	0.330
I = 9	0.897	4.311	0.656	0.152	1.337	0.251
I = 10	0.876	5.938	0.599	0.101	1.425	0.185

TABLE 8.32

INDICES OF MIDDLE EASTERN CIF PRODUCT PRICES WITH VARYING YEARS.

Year = 1982 + I	U.S. Product	E.E.C. Product	African Product	Non-E.E.C. W. European Product
I = 0	1.000	1.000	1.000	1.000
I = 1	0.975	0.993	1.024	1.070
I = 2	0.927	0.979	1.075	1.225
I = 3	0.859	0.959	1.154	1.500
I = 4	0.776	0.933	1.270	1.965
I = 5	0.684	0.902	1.431	2.751
I = 6	0.588	0.865	1.650	4.116
I = 7	0.493	0.825	1.947	6.574
I = 8	0.404	0.781	2.352	11.204
I = 9	0.323	0.735	2.906	20.361
I = 10	0.252	0.687	3.671	39.419

TABLE 8.33

INDICES OF FAR EASTERN CIF PRODUCT PRICES WITH VARYING YEARS.

Year = 1982 + I	U.S. Product	E.E.C. Product	Middle Eastern Product	Non-E.E.C. W. European Product
I = 0	1.000	1.000	1.000	1.000
I = 1	1.032	0.979	1.054	1.009
I = 2	1.098	0.940	1.169	1.027
I = 3	1.206	0.883	1.367	1.055
I = 4	1.365	0.813	1.682	1.093
I = 5	1.594	0.733	2.180	1.142
I = 6	1.919	0.647	2.972	1.204
I = 7	2.381	0.561	4.263	1.281
I = 8	3.044	0.476	6.427	1.374
I = 9	4.009	0.396	10.180	1.486
I = 10	5.435	0.323	16.930	1.620

TABLE 8.34

INDICES OF AFRICAN CIF PRODUCT PRICES WITH VARYING YEARS.

Year = 1982 + I	U.S. Product	E.E.C. Product	Middle Eastern Product	Far Eastern Product
I = 0	1.000	1.000	1.000	1.000
I = 1	1.050	1.013	0.989	0.995
I = 2	1.159	1.039	0.967	0.984
I = 3	1.342	1.079	0.936	0.968
I = 4	1.632	1.136	0.896	0.948
I = 5	2.082	1.210	0.848	0.923
I = 6	2.788	1.305	0.794	0.893
I = 7	3.915	1.425	0.735	0.861
I = 8	5.761	1.575	0.674	0.825
I = 9	8.882	1.763	0.611	0.787
I = 10	14.336	1.996	0.549	0.746

TABLE 8.35

INDICES OF NON-E.E.C. W. EUROPEAN CIF PRODUCT PRICES WITH VARYING YEARS.

Year = 1982 + I	U.S. Product	Canadian Product	E.E.C. Product	Middle Eastern Product	Far Eastern Product	African Product
I = 0	1.000	1.000	1.000	1.000	1.000	1.000
I = 1	0.991	1.028	0.996	1.063	1.037	1.034
I = 2	0.972	1.085	0.989	1.202	1.116	1.106
I = 3	0.945	1.178	0.978	1.446	1.245	1.224
I = 4	0.910	1.313	0.963	1.847	1.441	1.400
I = 5	0.869	1.504	0.946	2.507	1.728	1.655
I = 6	0.822	1.769	0.925	3.614	2.148	2.022
I = 7	0.770	2.137	0.901	5.529	2.766	2.552
I = 8	0.715	2.650	0.875	8.972	3.690	3.328
I = 9	0.658	3.372	0.847	15.433	5.095	4.479
I = 10	0.600	4.402	0.816	28.116	7.281	6.223

relationships between price and transport costs. All other cases where the indices are less than one occur when this parameter is statistically insignificant (see Table 6.8).

The ratios of the simulated CIF prices to the 1982 CIF prices are presented in Tables 8.28 through 8.35. There are no apparent patterns except that all but three of the ratios whose parameter on year is significant are greater than one. The distance between regions does not appear to be a major factor in the size of the ratios. This can be explained by the fact that the variable year accounts for transport and handling costs. Transport costs are probably a function of distance but handling costs may not be. These costs will differ from product to product depending upon the types of storage necessary and/or available and the costs of labor. The differences in handling costs could outweigh the impacts of distances on CIF product prices from product to product.

Export Supplies

The export supply function measures the strength of the relationship between export supply, the average export price, and production levels. It is expressed in (4.20) or, to repeat,

$$(8.4)\ \log [\ X(.j) - X(jj)\ ] = \log \rho(0j) + \rho(1j) \log F(.j) + \rho(2j) \log X(.j)$$

Three types of simulations were carried out on export supplies. The average export price was varied from 50 to 150 percent of its 1982 level in increments of 10 percent and production was varied from 90 to 120 percent. Then they were both varied by these same percentages, simultaneously. In all cases ratios of the simulated export supplies with respect to the 1982 supplies were calculated, along with regional shares of total world vegetable exports. The results are presented in Tables 8.36 through 8.41.

In order to do these simulations in a meaningful manner, it was necessary to put restrictions on the intercept and production parameter of the Far East's export supply relationship. Given the estimated value of these two parameters, -5.420 and 30.474 respectively, any simulations varying production levels would cause the Far East to totally dominate over all other regions (see Table 6.10). This would not allow the simulations on export supply to yield any meaningful information regarding the responses of other regions to changes in production levels and/or the average export price. Therefore the decision was made to restrict the Far East's export supply to change linearly with changes in production, thus the parameter on this variable was assigned the value of 1.000. With the production parameter given the value of 1.000, the intercept had to be assigned a value such that the functional relationship would yield the actual export supply quantity

for 1982, the base year of the simulations. This value was log(.002531). While ideally, simulations would be carried out using only the estimated parameters, the production parameter and intercept for the Far East in this relationship are so large as to be unbelievable. The t values indicate that these parameters are statistically significant, however, the tremendous growth experienced by the Far East in all aspects of international vegetable trade has probably skewed the econometric results such that none of its estimated parameters are totally reliable.

Simulations Varying Average Export Prices

In this set of simulations the average export prices were varied from 50 to 150 percent of their 1982 levels. There are eleven values for export supplies for each region in this set. Indices of regional export supplies were calculated with simulated supplies divided by 1982 supplies. These are presented in Table 8.36. Actual 1982 regional shares of total world exports are presented in Table 8.37.

Looking at the indices of export supplies, all regions' supply levels drop with a fall in prices except that of the Far East (see Table 8.36). The parameter on price is statistically significant and so this wrong sign cannot be casually disregarded. Nevertheless, as with other Far Eastern parameters, it is probably not totally reliable.

TABLE 8.36

INDICES OF EXPORT SUPPLIES WITH VARYING AVERAGE EXPORT PRICES.[a]

% of 1982 Average Export Price	Latin American Product	U.S. Product	Canadian Product	E.E.C. Product	Middle Eastern Product	Far Eastern Product	African Product	Non-E.E.C. W. European Product
50	0.744	0.353	0.875	0.898	0.999	43.082	0.845	0.663
60	0.804	0.464	0.907	0.923	0.992	16.011	0.883	0.739
70	0.859	0.585	0.934	0.946	0.995	6.934	0.917	0.809
80	0.909	0.715	0.958	0.966	0.997	3.358	0.947	0.876
90	0.956	0.853	0.980	0.984	0.998	1.772	0.975	0.939
100	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
110	1.042	1.154	1.018	1.015	1.001	0.596	1.023	1.058
120	1.081	1.315	1.036	1.029	1.003	0.372	1.045	1.114
130	1.119	1.484	1.052	1.042	1.004	0.241	1.066	1.168
140	1.545	1.659	1.067	1.054	1.005	0.161	1.085	1.221
150	1.189	1.840	1.081	1.065	1.006	0.111	1.104	1.272

[a] Index i = $\frac{\text{Export i with varied price}}{\text{Export i with 1982 price}}$

TABLE 8.37

1982 REGIONAL EXPORT SHARES.

Latin America	8.593
U.S.	10.021
Canada	3.092
E.E.C.	6.674
Middle East	3.654
Far East	58.007
Africa	2.864
Non-E.E.C. W. Europe	7.096

The U.S. experiences the largest drop in supply with a fall in price. This region's export levels are very sensitive to price. As the simulated prices rise, its supplies increase. The next largest changes are experienced by the Non-E.E.C. Western European region. The Middle East has very little change in its export levels with price changes. The E.E.C., Canada, Africa, and Latin America have moderate changes.

As would be expected, regional export shares reflect these levels of change in supplies (see Table 8.38). With prices only 80 percent of their 1982 levels, the Far East dominates world vegetable exports with 84 percent of the total. At prices 120 percent of 1982 levels, the Far East's share declines to 31 percent. It is still the dominant supplier but its share is much smaller. At that price level, the U.S. holds 19 percent of the market, Latin America 13 percent, the Non-E.E.C. Western European region 12 percent, and the E.E.C. 10 percent.

Simulations Varying Production Levels

Table 8.39 presents indices of export supplies from simulations involving varying production levels from 90 to 120 percent of their 1982 levels. Two regions show increases in exports with lower production levels, the U.S. and Africa. The production parameter for the U.S. is statistically insignificant and so its result can be ignored

TABLE 8.38

REGIONAL EXPORT SHARES WITH VARYING AVERAGE EXPORT PRICES.

% of 1982 Average Export Price	Latin America	U.S.	Canada	E.E.C.	Middle East	Far East	Africa	Non-E.E.C. W. Europe
50	0.253	0.140	0.107	0.237	0.143	98.839	0.096	0.186
60	0.719	0.484	0.292	0.642	0.378	96.677	0.263	0.546
70	1.690	1.342	0.661	1.446	0.832	92.112	0.601	1.315
80	3.371	3.091	1.278	2.781	1.571	84.005	1.170	2.682
90	5.775	6.012	2.130	4.615	2.565	72.254	1.962	4.686
100	8.593	10.021	3.092	6.674	3.654	58.007	2.864	7.096
110	11.313	14.619	3.981	8.562	4.625	43.704	3.705	9.491
120	13.528	19.199	4.664	10.000	5.336	31.398	4.360	11.515
130	15.099	23.358	5.109	10.922	5.763	21.931	4.795	13.024
140	16.091	26.960	5.350	11.408	5.957	15.143	5.040	14.051
150	16.643	30.037	5.445	11.581	5.989	10.457	5.148	14.701

TABLE 8.39

INDICES OF EXPORT SUPPLIES WITH VARYING PRODUCTION LEVELS.

% of 1982 Average Export Price	Latin America	U.S.	Canada	E.E.C.	Middle East	Far East	Africa	Non-E.E.C. W. Europe
90	0.770	1.100	0.916	0.952	0.942	0.900	1.252	0.936
95	0.881	1.047	0.958	0.976	0.971	0.950	1.116	0.969
100	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
105	1.129	0.957	1.042	1.023	1.028	1.050	0.901	1.031
110	1.266	0.918	1.083	1.046	1.056	1.100	0.816	1.061
115	1.414	0.882	1.124	1.068	1.083	1.150	0.742	1.091
120	1.571	0.849	1.164	1.090	1.120	1.200	0.677	1.121

(see Table 6.10). However, that for Africa is significant. Perhaps there is a negative relationship between production and exports in Africa. Possibly as production dropped, a shift occurred in the mix of vegetables grown such that more varieties suitable for export were produced. This is a possible explanation, particularly since Africa shifted away from home use crops and towards export crops from 1962 to 1982.

All other regions show a positive relationship between production and exports. The widest range of variation is seen in the Far East and the smallest in the E.E.C. The response of exports to production levels in the Far East is so strong as to be unbelievable. The results are probably not accurate. Latin America also shows a fairly large range in export activity with variations in production levels, but these are of a believeable nature. Canada, the E.E.C., the Middle East, and the Non-E.E.C. Western European region show moderate export responses to variations in production levels.

Results on shares of total world exports follow a very similar pattern (see Table 8.40). U.S. and African shares increase with production decreases and decreases with increases in production levels. Far Eastern shares range from 56 percent at production levels of 90 percent of 1982 levels to almost 60 at 120 percent. Latin American shares show the next largest variability. Canadian, E.E.C., Middle

TABLE 8.40

REGIONAL EXPORT SHARES WITH VARYING PRODUCTION LEVELS.

% of 1982 Average Export Price	Latin America	U.S.	Canada	E.E.C.	Middle East	Far East	Africa	Non-E.E.C. W. Europe
90	7.140	11.887	3.055	6.850	3.712	56.320	3.869	7.167
95	7.861	10.902	3.078	6.767	3.687	57.247	3.319	7.139
100	0.593	10.021	3.092	6.674	3.654	58.007	2.864	7.096
105	9.333	9.230	3.100	6.573	3.616	58.623	2.483	7.041
110	10.082	8.520	3.102	6.467	3.574	59.114	2.164	6.977
115	10.836	7.880	3.099	6.358	3.529	59.497	1.895	6.906
120	11.595	7.303	3.092	6.247	3.482	59.785	1.666	6.830

Eastern, and Non-E.E.C. Western European shares vary moderately.

Simulations Varying Average Export Prices and Production Levels

Table 8.41 presents results of simulations on export supplies with variations in both the average export price and production levels in the form of regional export shares. Prices were varied from 50 to 150 percent of their actual 1982 levels, in increments of 10 percent. At each price level, production was varied from 90 to 120 percent of its 1982 level. Therefore there are seven simulated scenarios at each price level.

With prices 50, 60, 70, and 80 percent of their 1982 levels the Far East dominates export supplies. Its shares range from a high of almost 99 percent to a low of approximately 84 percent. With price variations at more realistic levels, from 90 to 110 percent of their base level, the Far East is still the major supplier, but not totally dominant. With prices 120 to 150 percent of the base level, the Far East, while still an important supplier, is not close to being dominant. In these price ranges, its shares range from a high of 33 percent to a low of approximately 10 percent. The United States and Latin America become the more dominant suppliers in these higher price ranges.

TABLE 8.41

REGIONAL EXPORT SHARES WITH VARYING AVERAGE EXPORT PRICES AND PRODUCTION LEVELS.

% of 1982 Price	% 1982 Production	Latin America	U.S.	Canada	E.E.C.	Middle East	Far East	Africa	Non-E.E.C. W. Europe
50	90	0.216	0.171	0.109	0.250	0.150	48.779	0.133	0.193
50	95	0.234	0.154	0.108	0.243	0.146	98.812	0.112	0.190
50	100	0.253	0.140	0.107	0.237	0.143	48.839	0.096	0.186
50	105	0.272	0.127	0.106	0.231	0.140	98.859	0.082	0.183
50	110	0.291	0.117	0.105	0.225	0.137	98.874	0.071	0.180
50	115	0.311	0.107	0.105	0.220	0.135	98.884	0.062	0.177
50	120	0.331	0.099	0.104	0.215	0.132	98.891	0.054	0.174
60	90	0.614	0.590	0.296	0.677	0.394	96.496	0.366	0.567
60	95	0.666	0.533	0.294	0.659	0.386	96.598	0.309	0.556
60	100	0.719	0.484	0.292	0.642	0.378	96.677	0.263	0.546
60	105	0.773	0.441	0.290	0.626	0.370	96.738	0.226	0.536
60	110	0.829	0.404	0.288	0.611	0.363	96.784	0.196	0.527
60	115	0.886	0.371	0.286	0.597	0.356	96.816	0.170	0.519
60	120	0.943	0.343	0.284	0.584	0.350	96.838	0.149	0.510
70	90	1.439	1.632	0.670	1.521	0.867	91.676	0.833	1.362
70	95	1.563	1.477	0.666	1.482	0.849	91.920	0.705	1.338
70	100	1.690	1.342	0.661	1.446	0.832	92.112	0.601	1.315
70	105	1.819	1.225	0.657	1.411	0.816	92.261	0.517	1.294
70	110	1.951	1.123	0.653	1.379	0.801	92.373	0.447	1.273
70	115	2.085	1.033	0.649	1.348	0.787	92.456	0.389	1.253
70	120	2.222	0.953	0.645	1.319	0.773	92.510	0.341	1.234

TABLE 8.41--continued

% of 1982 Price	% of 1982 Production	Latin America	U.S.	Canada	E.E.C.	Middle East	Far East	Africa	Non-E.E.C. W. Europe
80	90	2.856	3.738	1.288	2.911	1.628	83.206	1.612	2.762
80	95	3.111	3.392	1.283	2.845	1.599	83.679	1.369	2.722
80	100	3.371	3.091	1.278	2.781	1.571	84.055	1.170	2.682
80	105	3.635	2.827	1.272	2.720	1.544	84.350	1.008	2.643
80	110	3.905	2.595	1.266	2.661	1.518	84.578	0.873	2.604
80	115	4.178	2.389	1.259	2.605	1.492	84.749	0.761	2.566
80	120	4.456	2.207	1.252	2.550	1.467	84.871	0.667	2.529
90	90	4.851	7.210	2.128	4.789	2.634	70.922	2.680	4.785
90	95	5.309	6.574	2.131	4.703	2.600	71.659	2.286	4.738
90	100	5.775	6.012	2.130	4.615	2.565	72.254	1.962	4.686
90	105	6.248	5.516	2.127	4.527	2.528	72.728	1.695	4.632
90	110	6.727	5.075	2.122	4.440	2.491	73.100	1.472	4.575
90	115	7.211	4.682	2.144	4.354	2.453	73.384	1.286	4.517
90	120	7.701	4.330	2.105	4.269	2.415	73.593	1.128	4.458
100	90	7.140	11.887	3.055	6.850	3.712	56.320	3.869	7.167
100	95	7.861	10.902	3.078	6.767	3.687	57.247	3.319	7.139
100	100	8.593	10.021	3.092	6.674	3.654	58.007	2.864	7.096
100	105	9.333	9.230	3.100	6.573	3.616	58.623	2.483	7.041
100	110	10.082	8.520	3.102	6.467	3.574	59.114	2.164	6.977
100	115	10.836	7.880	3.099	6.358	3.529	59.497	1.895	6.906
100	120	11.595	7.303	3.092	6.247	3.482	59.785	1.666	6.830
110	90	9.290	17.138	3.887	8.686	4.694	41.936	4.946	9.474
110	95	10.294	15.820	3.941	8.636	4.642	42.900	4.271	9.497
110	100	11.313	14.619	3.989	8.562	4.625	43.704	3.705	9.491
110	105	12.343	13.526	4.009	8.471	4.598	44.366	3.227	9.460
110	110	13.382	12.531	4.026	8.365	4.561	44.903	2.823	9.409
110	115	14.426	11.625	4.035	8.249	4.518	45.329	2.479	9.341
110	120	15.473	10.799	4.035	8.124	4.468	45.657	2.185	9.260

TABLE 8.41--continued

% of 1982 Price	% of 1982 Production	Latin America	U.S.	Canada	E.E.C.	Middle East	Far East	Africa	Non-E.E.C. W. Europe
120	90	10.987	22.259	4.503	10.033	5.299	29.795	5.757	11.367
120	95	12.247	20.670	4.593	10.035	5.328	30.663	5.001	11.464
120	100	13.528	19.199	4.664	10.000	5.334	31.398	4.360	11.515
120	105	14.824	17.841	4.717	9.937	5.333	32.012	3.814	11.527
120	110	16.130	16.589	4.755	9.849	5.305	32.518	3.335	11.507
120	115	17.442	15.436	4.779	9.741	5.270	32.926	2.949	11.458
120	120	18.754	14.374	4.792	9.617	5.224	33.246	2.606	11.387
130	90	12.146	26.825	4.886	10.854	5.668	20.614	6.272	12.735
130	95	13.609	25.036	5.009	10.911	5.728	21.323	5.475	12.909
130	100	15.099	23.358	5.109	10.922	5.763	21.931	4.795	13.024
130	105	16.610	21.789	5.187	10.895	5.776	22.446	4.221	13.088
130	110	18.132	20.327	5.245	10.834	5.770	22.875	3.709	13.100
130	115	19.661	18.967	5.287	10.745	5.748	23.227	3.276	13.089
130	120	21.199	17.704	5.314	10.633	5.712	23.508	2.901	13.038
140	90	12.843	30.721	5.077	11.249	5.813	14.123	6.542	13.633
140	95	14.449	28.791	5.227	11.355	5.899	14.669	5.735	13.876
140	100	16.091	26.960	5.350	11.408	5.957	15.143	5.040	14.051
140	105	17.758	25.231	5.449	11.416	5.989	15.549	4.441	14.166
140	110	19.441	23.605	5.527	11.385	6.000	15.891	3.923	14.228
140	115	21.133	22.080	5.585	11.319	5.992	16.176	3.474	14.243
140	120	22.825	20.653	5.624	11.225	5.967	16.406	3.083	14.217
150	90	13.200	34.010	5.134	11.347	5.807	9.691	6.639	14.173
150	95	14.900	31.980	5.303	11.492	5.913	10.099	5.839	14.474
150	100	16.643	30.037	5.445	11.581	5.989	10.457	5.148	14.701
150	105	18.418	28.187	5.561	11.621	6.038	10.766	4.548	14.862
150	110	20.212	26.434	5.654	11.617	6.063	11.030	4.027	14.963
150	115	22.018	24.779	5.725	11.575	6.068	11.252	3.573	15.011
150	120	23.825	23.222	5.777	11.501	6.054	11.433	3.177	15.011

Conclusion

Simulations were conducted for each region on the four functional relationships of the vegetable trade system. Simulations are important in that economic variables are constantly in flux, they are not static. Assuming that, at least in the short run, the strength of the relationships between variables does not change, the parameters estimated with the nonlinear 2SLS procedure can be used to simulate the reactions of the dependent variables to changes in explanatory variables.

CHAPTER IX

CONCLUSIONS OF THE STUDY

Introduction

In Chapters I through VIII a research project studying international trade of fresh vegetables was designed, presented, and its conclusions and implications discussed. The study contributes to agricultural economics literature in several ways. First it uniquely alters the Armington model, making it more flexible and hence more able to accurately reflect the reality of the economic situation being studied. This altered version of the Armington model is then empirically estimated in a simultaneous system. There has been only one other study which estimated this type of model in a simultaneous system (Winters,1984a). Finally, this model is a world trade model for fresh vegetables. Its empirical estimation yields parameters for market demand, product demand, export supply, and CIF product price relationships for each of the major trading regions in this commodity. These parameters are then used to simulate fresh vegetable trade with changes in several variables such as the average market price of vegetables, population, GDP, production, and tariffs.

To briefly review the dissertation, Chapter I discusses the importance and characteristics of international trade in general. The specific topics covered include national agricultural and trade policies, the nature of competition in agricultural trade, and the importance of vegetable trade. It then goes on to develop the problem statement, with specific goals for the study, the scope of the dissertation, and the methodology to be used. Chapter II focuses on characteristics of trade and production of fresh vegetables world wide. It specifically covers levels, percentages, and growth of production and trade, and trade patterns observed for fresh vegetables from 1962 to 1982. A literature review of work in international trade is presented in Chapter III. There are two areas of focus based on the two most widely used methods of obtaining empirical estimates of demand and supply functions in trade research. These include the direct application of standard econometric techniques and the use of those techniques within the confines of a world trade model, such as the Armington model. The trade model used in this study is developed in Chapter IV. The theoretical basis of the model is presented , followed by its generalized presentation. The specific functional representation, along with the system as specified for estimation is then covered. Chapter V concentrates on relevant econometric issues for the study. The trade system developed in Chapter IV is presented in

matrix algebra. There is a discussion of nonlinear simultaneous systems and problems involved in their estimation and the identifiability of the equations. There is also a discussion of the procedures available with SAS for working with nonlinear simultaneous systems and a determination of those most appropriate for the vegetable system of this study. Finally, the data used in estimation of the system are discussed. In Chapter VI the results of the econometric estimation are presented. Graphs of the actual data observed along with the points predicted by the model are included for the major relationships. Statistics indicating model performance and the actual estimated parameters are included for every functional relationship. In Chapter VII the estimation results are discussed in relation to the observed world trade patterns in fresh vegetables. Each of the regions are discussed separately with respect to their exports and imports. Chapter VIII presents the simulation results and their implications for world vegetable trade. Simulations were carried out on each of the four types of functional relationships, market demands, product demands, CIF import prices, and export supplies for each of the eight regions.

Contributions of This Study to Agricultural Economics Research

This study contributes to agricultural economics literature in several ways. First, the construction of the

model is such that vegetables produced in different regions are not considered perfect substitutes. Typically in international trade research, products of the same type of good produced in different regions or nations are considered homogeneous and therefore perfect substitutes. This implies that the elasticities of substitution between the products are infinite. The model designed for this study is built on Armington's theory of demand as distinguished by place of production. This theoretical construct assumes that products produced in different regions are not homogeneous, thus not perfect substitutes. Therefore their elasticities of substitution are not infinite. Armington, by his use of the CES function in the derivation of the product demand equations, assumes that the products competing in a market have constant and equal elasticities of substitution, but every market does not have the same substitution properties. This, while an improvement over assuming all products are perfectly substitutable, is still very restrictive with regards to the possible relationships between products.

The study conducted in this dissertation alters the Armington model such that it is more flexible and consequently more likely to accurately reflect the economics of international fresh vegetable trade. The CRES function, constant ratio of elasticities of substitution, is used in the derivation of the product demands. The resulting functional relationships impose that all products competing

in a market have elasticities of substitution that vary by a constant ratio, but they do not all have the same elasticity. The use of this approach, where products are distinguished by their place of production and allowed to have varying elasticities of substitution, lends more flexiblity to the model than is typically the case in trade research. This flexibility also lends more credibility to the model's results than would use of more restrictive functional forms.

The third contribution this study makes to agricultural economics research is that the trade system is estimated simultaneously. Typically international trade models are estimated with single equation techniques. This approach, where OLS is used to estimate the equations of a trade system, implicitly assumes that the export and import supply price elasticities facing any individual country are infinite. This may be reasonable in the case of the supply of imports to a single country but probably is not for the case of the supply of exports from an individual country. It is not likely that an increase in world demand for a country's exports can be satisfied without an increase in the price of its exports unless idle capacity exists or production is subject to constant or increasing returns to scale. The quantity supplied will be a function of price. Because demand is also a function of price, simultaneity exists. The use of OLS will yield biased and inconsistent

estimators. To the researcher's knowledge, this is only the second study to estimate a model based on Armington's theory of demand as distinguished by place of production in a simultaneous system. Thus, in this dissertation Armington's original model is extended in that it is rendered more flexible and it is empirically implemented in a theoretically consistent manner.

The trade system for fresh vegetables is estimated with nonlinear 2SLS using principal components as instruments. The parameters, then, while biased, are consistent. This is a significant improvement over the use of OLS. While the t statistics calculated from the estimation of a simultaneous system are not totally accurate, they do give some indication of the statistical significance of the parameters. The t statistics from its estimation indicate that this study's trade system does a good job in capturing and explaining the economics of international fresh vegetable trade. Other statistics which support this conclusion include the percentage root mean square errors, Theil inequality coefficients, and R squares. Also, graphs of the more important relationships which plot actual and predicted values, illustrate that the model captures the major trends and turning points in the trade of this commodity.

The fourth major contribution is its broad analysis of international fresh vegetable trade. The trade of this good

grew tremendously from 1962 to 1982. The economic forces driving this trade have been virtually unstudied; there has been little economic analysis of fresh vegetable trade. The market demands for fresh vegetables, the product demands, CIF price relationships, and the export supply functions are all estimated for each of the eight regions of the world which participate to a significant degree in the trade of fresh vegetables. The parameters for each of these relationships, for each of the regions, are presented and discussed in Chapters VI and VII, where Chapter VII, in particular, focuses on relating the estimation results to observed trends in fresh vegetable trade. Chapter VIII uses the estimated parameters to simulate these four types of relationships with changes in some of the more important economic variables involved in this trade. The variables whose values are varied include the average market prices, GDP and population levels, product prices, year, which is a proxy for transport and handling costs, average export prices, and production levels. These simulations give indications of the directions market demands, product demands, CIF import prices, and export supplies may take in the near future for each of the eight regions.

Difficulties in Implementation

Several difficulties were encountered in implementing this project. One of the most difficult was that of data

availability. Several types of data were needed in order to estimate the world trade system in fresh vegetables. Each of these had to be located independently. Trade data itself were needed on a yearly basis, incuding the quantity and value of vegetables exchanged between a trading country and its partner. These are more detailed trade data than are readily available, it was necessary to contact several people at the United Nations and the U.S. Department of Agriculture before a suitable data tape could be located. Financial data were also needed, specifically exchange rates and GDP levels, by country, on a yearly basis. These were obtained from a data tape at the University of Florida. Yearly production levels of fresh vegetables, by country, were obtained from the USDA. These data were also difficult to locate. The most problems, however, were encountered in trying to obtain data on tariffs.

Latin America, Africa, and the Middle East, in general, do not rely on tariffs to regulate their imports of fresh vegetables. For this reason they were assumed tariff levels of zero in the estimation of the model. The U.S., E.E.C., Canada, and the Non-E.E.E. Western European region, however, use tariffs as an integral part of their import policies. Tariff levels on fresh vegetables for each of these regions were needed and all but impossible to obtain in the cases of the U.S. and the E.E.C. As these are two of the most important regions of the world with regards

to trade, it would be helpful if the government of the U.S. and agencies responsible for international trade issues of the E.E.C. made information on their tariff policies available. While it is not available, all research on trade involving these regions is compromised and suspect.

Tariff policies of Canada and Japan were not difficult to obtain, particularly those of Japan. This nation's tariff levels are published yearly, by commodity, in both English and Japanese. Descriptive information on the tariff policies of other Far Eastern nations were also available so that it was possible, with the detailed listing of Japan's tariffs, to formulate a level representative of the entire region.

Once the data were obtained and put into the form needed for the vegetable trade system, it was possible to begin attempting to estimate the system. There are eighty-two exogenous variables and only twenty-one observations in the data set. If the standard method of creating instrumental variables for stage one of the two stage estimation process was used, regressing each of the endogenous variables on all of the exogenous variables of the system, it would use a degree of freedom for each exogenous variable. The data set is not large enough for that approach. Therefore the method of principal components was used and discussed in detail in Chapter V.

Performance of the Trade Model as Revealed by Econometric Results

The econometric results for the world trade system for vegetables generally make economic sense and yield insights into the trends observed in Chapter II. For almost every functional relationship in the system, every region is responsive to at least one of the explanatory variables. Graphs of each market demand, export supply, and several product demands demonstrate that these functional specifications capture the general direction taken by each in the actual data. This speaks very well of the model; it captures the real world trends occurring in fresh vegetable trade. Also, in general the graphs demonstrate that the functional specifications capture the major turning points in the data. There are a few major discrepancies between predicted and actual values. These outliers are usually isolated, only in one or two of a few years, and generaly occur in the relationship of a third world nation where a weaker infrastructure for data collection exists. All of this indicates that the outliers probably reflect data problems rather than problems with model construction.

Statistics regarding the fit and performance of the model indicate that, in general, the model does a good job in capturing the economic forces involved in international fresh vegetable trade. The Durbin Watson statistics are usually close to 2, indicating little serial correlation and

a well specified model. The R square statistics range from quite low, close to zero, to quite high, close to one. Some of the R square statistics are negative, which is theoretically impossible. This is the result of using a highly restrictive, nonlinear model. For a model of this sort, the R square statistics can give some signals as to the explanatory power of the individual equations, but they are not valid for statistical tests. Because of this, root mean square percent errors and Theil inequality coefficients were also used to evaluate the performance of the fresh vegetable trade model.

These three types of statistics indicate that the market demands and export supplies capture the variability in the endogenous variables, predict their values, and capture the turning points in the historical data better than do those for the product demands and CIF import prices (see Tables 6.1, 6.2, 6.3, and 6.4). In general, the R square statistics are higher and the root mean square errors and Theil inequality coefficients lower for the market demand and export supply relationships than those for the product demands and CIF import prices. Nevertheless, the estimation results for all four types of relationships yield insights into the economics driving international fresh vegetable trade.

The empirical results and observed trends indicate that demand drives international trade in fresh vegetables, not

supply. The market demand functions specified in this model do a good job in capturing those forces and so, to a lesser extent, do the product demands. The empirical results for the market demand relationships indicate that in virtually every region, there is a negative price response as regards to fresh vegetable demand (see Table 6.7). For those regions with a positive price response, the t statistics are so small as to indicate that the parameters are statistically insignificant. Also the income and population responses are generally positive, or statistically insignificant. The sensitivities to these variables vary from market to market. Empirical results for the product demands are less theoretically consistent. Many of the relative price parameters are positive and have t statistics large enough to render it impossible to dismiss these results as statistically insignificant (see Table 6.8). This problem is discussed more extensively later in this chapter. In general it can be stated that the price elasticities of the product demands are such that those for a region's major suppliers are more inelastic than those for its less important suppliers. These results indicate that trade patterns with established suppliers are likely to remain relatively constant, while those of emerging suppliers are likely to be more volatile. The product demands most often indicate positive market size responses, which is theoretically consistent.

The export supply functions indicate that this endogenous variable is usually related in a positive and inelastic manner to the average export price (see Table 6.10). Its response to production is also generally positive, with about half of the regions responding in an elastic manner and about half in an inelastic manner. The largely inelastic responses, along with the lower levels of growth in export supplies as compared to imports, are evidence that the growth in international trade of fresh vegetables is driven by an increase in the strength of demand and not by changes in supplies.

The CIF import price functional relationships, while showing high R square values, also generally have high percentage root mean square errors and Theil inequality coefficients (see Table 6.5). This functional specification is thus less accurate in terms of predictive ability and in capturing turning points in the historical data than those for market demands, product demands, and export supplies. This is probably the result of using the trend variable year as a proxy for transportation and handling costs. By construction, year is an ever increasing variable, whereas it is not clear that transportation and handling costs increase every year for all trade flows in the model. This is probably the result of using the trend variable year as a proxy for transportation and handling costs. By construction, year is an ever increasing variable, whereas

it is not clear that transportation and handling costs increase every year for all trade flows in the model. These CIF relationships do, however, give insights as to the regional fluctuations at this price level. For Latin America, Canada, the Far East, and the Non-E.E.C. Western European region, much of the volatility appears to be due to changes in transportation and handling costs. In contrast, for the U.S., E.E.C., the Middle East, and Africa, the FOB prices appear to have more of an impact on CIF import price changes than do transportation and handling costs (see Table 6.9).

Observed Trends in Trade and Implications of Econometric Results for These Trends

Trade in fresh vegetables generally occurs within the two blocs of the Americas and Europe-Asia-Africa. The primary suppliers for Latin America, the U.S., and Canada are each of the other two. The two European regions, the largest markets for fresh vegetables, receive much of their vegetable imports from within Europe. There is evidence of change occurring in these patterns with the emergence of the Far East as an important supplier and the growth of the Middle Eastern, Far Eastern, and African import markets. While these three import markets are still small, they do show potential for continued growth and, according to empirical results, all regions could expand their exports to them. Increased exports from the American regions to the

E.E.C. are hindered by the CAP. Empirical results indicate that market shares in the E.E.C. are largely determined by price competition. The CAP puts vegetables from Latin America, the U.S., and Canada at a disadvantage to those from the Middle East and Africa as these two regions receive preferential treatment. Combined with the high costs of transport and handling, it is difficult for vegetables from the Americas to compete in the E.E.C. market. High transportation and handling costs also make it more difficult for these products to compete in the Middle East, Africa, and the Far East. Improved technology, which would likely lower these costs, could help American exporters gain shares in these distant markets.

Implications of Simulation Results

Simulations were conducted on each of the functional relationships whereby one or more of the explanatory variables were varied and the impacts on the dependent variable measured. These were done on a single equation basis, simultaneous effects were not measured. For almost all of the simulations, eleven scenarios were constructed. Because the parameters used to carry out the simulations were estimated with data from 1962 to 1982, the first few simulation results are probably the most likely to reflect future trends accurately. Beyond a few years, the economic relationships most likely shifted enough that the parameter

estimates used are no longer accurate, causing the simulations to be unrealistic projections.

Three types of simulations were carried out on the market demand equations, the average market prices were varied from 50 to 150 percent of their 1982 values, regional GDP and population levels were simultaneously varied according to realistic proportions, and regional GDP levels were all varied by 3 percent while populations were varied according to realistic proportions. For the simulation where the average market price was varied, the results were not surprising when the market demand parameters were considered. The simulated market demands for Latin America, the U.S., the E.E.C., the Middle East, and the Non-E.E.C. Western European region reflect the negative relationship between price and quantity expected by economic theory. None of the results are extreme, although the Middle East's demand for vegetables increased by almost 50 percent when the average market price was decreased by 20 percent of its 1982 level. Canada, the Far East, and Africa were the opposite with their market demands decreasing as the average market price was decreased, and vice versa. The changes were, however, very small, indicating that this observed positive effect was probably no different from zero.

When GDP and population levels were both varied by realistic proportions, the Middle East showed the largest growth in its market demand. This result was due to both

the regional elasticities measured econometrically and to the trends occurring in these aspects of Middle Eastern society, particularly as regards GDP. The data indicate that GDP grew by approximately 30 percent a year from the late 1970's to 1982 and its demand parameter was estimated to be 3.119. When GDP was varied by only 3 percent, the Middle East's market demand for vegetables declined. These simulations indicate that the tremendous growth in GDP experienced by the Middle East in the 1970's and early 1980's fueled its increased demand for fresh vegetables. This region's GDP is presently not growing by 30 percent a year, due largely to the decline in oil prices. Therefore the first few simulations on this region's market demand for vegetables may accurately reflect reality, but beyond that, they probably do not.

Another noteable result of the simulation of GDP and population level variations by realistic proportions is that Latin America's market demand for vegetables declined. Data indicate that this region's growth in GDP was only about 1 percent a year in the late 1970's and early 1980's. When its GDP was simulated to grow by 3 percent, its market demand for vegetables increased, but only slightly. As this simulated growth in GDP is three times its actual growth, the results indicate that Latin America does not show much potential for growth as a vegetable importer. The rest of the results of simulations on market demands of variations

in GDP and population levels are not surprising when the regional parameter estimates are taken into consideration.

Simulations were also conducted on selected product demands. Those trade flows which account for a large percentage of vegetable trade, or which appear to have large growth potential, were selected. There were thirty-one of these. Because product demands are a function of the product's price relative to the average market price and the size of the vegetable market in that region, any changes in market demands also affect product demands. For that reason, the simulations conducted on the market demands were also conducted on the product demands. It is important to realize that the simulations on the product demands measure a compound effect, that of the variable changes on market demand, and the effect of changes in the market size on the product demands. None of the results were extreme or outstanding. Generally there was moderate variation in the product demands with the variations in the market demand.

The relative product prices were also varied and their effects on product demands measured. Variations in product prices in this model can be caused by exchange rate fluctuations or tariff barrier policy changes. The results of these simulations are significant in that they yield insight into the effects of these two very important variables in international trade on the flow of vegetable products around the world.

The E.E.C.'s demand for U.S. vegetables more than doubled when the relative price of this product was decreased to 80 percent of its 1982 level. These results are clear evidence that the protective policies of the CAP hinder the U.S.'s ability to compete in the E.E.C. Similar results were obtained concerning the E.E.C.'s demand for Far Eastern vegetables, indicating that this region would have captured an even larger share of the E.E.C. market if the CAP did not erect tariff barriers.

When the price to the U.S. of E.E.C. vegetables was decreased to 80 percent of its base level, this demand increased only slightly to 1.019 times the 1982 level. Also, these results are suspect as the price parameter on this product is statistically insignificant. All of this seems to indicate that trade agreements, not price, govern U.S. imports of E.E.C. vegetables. When the price of Latin American vegetables to the U.S. was decreased by 20 percent, this demand increased to 1.148 times the base level. Given the weakness of Latin American currencies, it is likely that the price of this product to the U.S. will drop. In that case, the simulation indicates that demand will increase.

Other important results from the simulation on product demands varying product prices were obtained for the Non-E.E.C. Western European region and Canada. Both of these regions charge moderate and uniform tariffs on their

vegetable imports. When the product prices to the Non-E.E.C. Western European region were dropped, simulating decreased tariffs, that region's demands for U.S., African, and Middle Eastern vegetables increased considerably. When the prices to Canada of U.S. and Latin American vegetables were dropped, its demands for these products increased.

Simulations were conducted on the CIF import price relationships where the year variable was trended upward, simulating an increase in transport and handling costs. As discussed earlier, this is not a totally satisfactory way to model transport and handling costs, but it was the best option available. It is important to realize that the parameters for this functional relationship were estimated using data from 1962 to 1982. During this time period there were years when the increasing costs of oil on the world market caused the costs of transport and handling to increase dramatically. The cost increases would have varied from region to region depending on the strength of their currencies. Currently, however, oil prices are not rising and have actually declined over the last few years. Therefore simulations using parameters based on rising oil costs do not reflect the current situation and their usefulness is limited.

The CIF import prices increased with transportation and handling cost increases in almost all cases with a statistically significant parameter on the year variable. The exceptions to this were the E.E.C.'s CIF import price

for Far Eastern and Non-E.E.C. Western European vegetables and the Non-E.E.C. Western European region's price for E.E.C. vegetables. In these cases there is a negative relationship between the CIF price and year.

There were no other apparent patterns in the CIF import price simulations. Distance between regions did not appear to be a major factor. This could be explained by the fact that the variable year accounts for transportation and handling costs. Transport costs may be a function of distance but handling costs probably are not. These costs will differ from product to product depending upon the types of storage necessary or available and the costs of labor. The differences in handling costs could outweigh the impacts of distance on CIF product prices from product to product.

Three sets of simulations were conducted on the export supplies. The average export prices were varied from 50 to 150 percent of their base levels, production levels were varied from 90 to 120 percent, and they were both varied simultaneously. In this last set, the price was first varied and all production variations were carried out at the different price levels.

Looking first at the results with only variations in the average export prices, with price decreases Far Eastern exports increased dramatically. All other regions' exports dropped, the U.S. experiencing the largest drop. With the price decreased by 20 percent, the Far East dominated world

export supplies with 84 percent of all supplies originating in this region. When the price was increased to 120 percent, the Far East supplied only 31 percent with the U.S. supplying 19 percent. Latin America's share also increased, as did the Non-E.E.C. Western European region's, and the E.E.C.'s share.

When production levels were increased, U.S. and African export supplies decreased. The parameter on this variable for the U.S. is insignificant, therefore production probably does not actually influence exports in this region. The decrease in African exports with production increases is probably due to a shift in product mix, causing more of its production to be consumed domestically. The Far East showed a wide range in exports with variations in production levels. The ranges were so large as to be unbelievable. These results are probably not accurate due to the tremendous increase in Far Eastern exports from 1962 to 1982. The E.E.C. showed very little variation in its exports of fresh vegetables with changes in production levels.

When both the average export price and production levels were varied there were some interesting results. With prices equal to 50, 60, 70, and 80 percent of their 1982 levels the Far East dominated export supplies at all levels of production. At more realistic price levels, from 90 to 110 percent, the Far East was still the major supplier

but was not totally dominate. With prices from 120 to 150 percent of the base level, the U.S. and Latin America dominated world export supplies of fresh vegetables at all levels of production.

Drawbacks and Limitations of the Study

Although the model used in this study was carefully designed and implemented, it does have drawbacks. The results indicate that there are some problems with empirical implementation of a model constructed in the Armington framework. In this study these problems are manifested in the frequency of obtaining positive demand price parameters. These results indicate either that the model is wrong in those cases, the data is wrong, or that possibly there are quality issues in the economic situation under study which are not addressed by the model. An Armington type model, while allowing products to differ by place of production, does not allow products to differ within the area of production, that is, it does not allow for changes in product characteristics over time. Changes in the quality levels of products are not accounted for by models built along Armington's theory of demand distinguished by place of production. This is a drawback of the model used in this study as it is likely that in a twenty one year span, the quality levels of the products involved did change. No definitive conclusions of this sort can be drawn, however, due to this limitation in the model.

Another limitation in the model is its lack of statistical validity for the Far East. This region experienced very strong growth in both its imports and exports, the highest growth rate of any region in the world. The growth, particularly on the export side, was so strong that the econometric results were dominated by it. While these results can and do give some insights as to the forces driving Far Eastern participation in international vegetable trade, they can only be taken as indicators. Their actual values and statistical validity are more suspect than those of the other regions due to the distorting effect of this strong growth.

Another limitation is the level of aggregation used, both in terms of the commodity and the traders. A study of the international trade of fresh vegetables, where all types of vegetables are aggregated, while giving a broad overview of this trade, does not say anything definite about any specific type of vegetable. It is possible that no vegetable type exhibits the characteristics shown to apply to fresh vegetables by this analysis, but with all vegetable types taken together, these are the traits which dominate trade in this commodity. It is also possible that no individual nations within the regional aggregations show the characteristics measured by this study, but again, taken together, regionally these are the dominant traits.

The levels of aggregation, while high, are justified with respect to the goals of this study. This is not an attempt to discover specifically what is occurring and why in the trade of particular types of vegetables. The focus is on more of a macro level. The idea is that once the trade of fresh vegetables is understood from a broad perspective, it will be easier to discover the economic forces operating on each specific type of vegetable. This is the task left to future research. Also, once it is known how the major regions of the world interact in the trade of fresh vegetables, it will be easier to discover exactly how specific nations within those regions fit in this scheme. This too, is a task left for future research. It must be pointed out, however, that while Latin American, Middle Eastern, Far Eastern, African, and Non-E.E.C. Western European nations are regionally aggregated, that is not the case with the U.S., Canada, and the E.E.C. The E.E.C., while regionally aggregated, has trade policies which are followed by all of its members and so it does behave as a single economic unit. Therefore, while regional aggregation may obscure the particular characteristics of trade in fresh vegetables for the individual nations of the developing regions, it does not for the western world, with the exception of the Non-E.E.C. Western European nations. This aggregation is justified as none of these nations participate in fresh vegetable trade to the extent that

their characteristics are crucial to understanding this trade.

Another limitation which has already been discussed is that of the lack of information regarding tariff policies. In order to implement the model it was necessary to impose tariffs for those regions known to use them as part of their trade policies. The unavailability of specific tariff levels often made it necessary to interpolate or guess the most appropriate level. This compromises the results of the estimations. Also, the study would be more accurate if non-tariff barriers were accounted for, however, information of this sort was almost totally unavailable. For this reason these types of trade barriers were not included in the analysis.

A final limitation of the study which needs to be specifically addressed is that of the single equation approach taken in the simulations. Because the system is simultaneous, changes in any of its variables would ultimately affect all other variables. Thus, to capture the total effect of these changes, a simultaneous method should be used to estimate the simulation scenarios. However, due to the complexity of the system, its size and nonlinearities, it was not possible to implement it in a simultaneous manner. No methodology could be discovered which was operable under these circumstances. Therefore single equation estimations were carried out to measure the impacts of changes in the specified variables.

Summary

Chapter IX presented a review of the study of international vegetable trade conducted in this dissertation. It was a very broad study, including all important regional traders and all types of fresh vegetables aggregated to one level, fresh vegetables. The model used contributes to international trade research in that it does not force vegetables produced in all regions of the world to be perfect substitutes. It allows the vegetable products competing in a market to have differing elasticities of substitution, as long as they all vary by a constant ratio. This is more flexibility than is generally found in international trade models and lends credibility to the results of the study. These results more closely reflect the reality of international vegetable trade than they would if a more rigid model were used. Also, the model is estimated simultaneously, which is unusual in international trade research. This is only the second study with an Armington type model to be estimated in this manner. Generally international trade models are estimated with single equation techniques, which, because supply and demand are determined simultaneously, yields biased and inconsistent parameter results.

There were several difficulties in implementation of the model including data availability, computer programming

of such a large and complex system, and the necessity of using principal components due to the large number of variables and small number of observations in the data set. These difficulties were all overcome and the means by which this was done are discussed in the various chapters of the dissertation.

The performance of the model was quite good as indicated by graphs of the most important demand and supply relationships and the R square, mean square percent errors and Theil inequality coefficients for all of the functions. The functional specifications capture the general directions and turning points of the historical data. They also explain much of the variability in the data, the explanatory power varying from equation to equation. The performance of the market demand and export supply equations is usually better than that of the product demand and CIF import price equations, as indicated graphically and statistically.

The historical patterns of trade in fresh vegetables have largely been confined to trade within the two blocs of the Americas and Europe-Asia-Africa. Empirical results indicate that there are strong economic forces at work to maintain those trade flows, but there are also forces working to cause some changes. The Middle East, Africa, and the Far East are emerging as participants in the trade of fresh vegetables. All three of these markets are growing as importers and the Far East, in particular, is becoming a

major exporter. The estimated elasticities provide evidence that all regions could increase their exports to the Middle East, Africa, and the Far East as these markets continue to grow. The Far East greatly expanded its exports to the E.E.C. from 1962 to 1982, largely capturing Africa's share of that market. The E.E.C.'s product demand elasticities for Far Eastern vegetables reveal a large price response to this product. Therefore it seems that the Far East is able to compete effectively in the E.E.C. market through price. This price advantage could come from improved infrastructure for transporting and handling vegetables. It does not come from preferential treatment by the CAP, which Africa does receive. The U.S., Latin America, and Canada also do not receive preferential treatment by the CAP. As the empirical results indicate that market shares in the E.E.C. are largely determined through price competition, the tariff policies of the CAP have definetly put the American regions at a disadvantage. The tariff barriers to their products, combined with the high costs of transport and handling, have worked in tandem to largely prevent the American regions from gaining substantial market shares in the E.E.C. As this is the largest import market in the world for fresh vegetables, it is clear from this study that the CAP is detrimental to U.S., Latin American, and Canadian exports of this good. A lowering of the tariffs imposed by the CAP on these vegetable products, combined with lower transportation

and handling costs, could substantially alter the established patterns of trade by allowing the American regions to be more competitive in the E.E.C. Decreased transportation and handling costs, which will likely be attained in the near future through improved technology and infrastructure, would also lower the price of vegetables from the American regions to the Middle East, Africa, and the Far East. This would likely improve their competitiveness in these markets.

Simulations were conducted on each of the four functional relationships. There were some noteable results of these. For market demand simulations, it became clear that the tremendous growth in GDP experienced by this region from the 1970's to 1982 was the primary cause of that region's strong growth as an import market. With the decline in oil revenues currently occurring, it is not likely that the Middle East will continue to grow as a fresh vegetable importer at such a high rate. The simulations also indicate that Latin America is not likely to be a strong market for vegetable imports, even if its GDP level triples. Simulations on product demands reveal that restrictive trade policies do indeed impact the levels and patterns of fresh vegetable trade. E.E.C. demand for U.S. and Far Eastern vegetables increase dramatically with simulated decreases in the prices of these products. Conversely, a price decrease to the U.S. of E.E.C.

vegetables does not have much effect on its level of demand for this product. This is evidence that trade agreements, not price, govern the flow of vegetables from the E.E.C. to the U.S. Simulations lowering prices of vegetable products to Canada and the Non-E.E.C. Western European region also show that demand in these regions will increase with decreased tariffs. Also, U.S. demand for Latin American vegetables will increase with lowered prices, indicating that with either an increase in the strength of the U.S. dollar, or a decrease in the strength of these currencies, this trade flow will increase. CIF import price simulations reveal that increases in transportation and handling costs do increase the CIF prices, but there were no apparent regional patterns to these increases. It is possible that the CIF import price equation, as specified, is unable to detect any patterns which may exist due to the use of the trend variable year. It is a poor proxy for transportation and handling costs. Distance does not appear to be a major factor in the CIF price, indicating that handling costs could be a large component of the prices of vegetable products. Export supply simulations reveal that with decreases in the average export prices, the Far East would become a dominant exporter and the U.S.'s share would decline. With increases in production levels, U.S. and African exports would decline while those of all other regions would increase.

Drawbacks and limitations of the study include the levels of aggregation used for both vegetables and regions, tariff data availability, the quality issue which cannot be clarified by any current Armington type model, and the use of a single equation technique to carry out the simulations. These are also all discussed earlier in the dissertation.

Future research possibilities building upon this work include studies concentrating on specific types of vegetables as well as concentrating on more specific geographical locations. Also, alterations of the Armington model to allow for changing product characteristics over time would be helpful in clarifying the unexpected and theoretically inconsistent parameter results. It would also be useful to explore means of conducting simulations of large models simultaneously in order to capture the total effects of variable changes.

APPENDIX A

REGIONAL COMPOSITIONS BY COUNTRY AND UNITED NATIONS COUNTRY CODES

APPENDIX A

REGIONAL COMPOSITIONS BY COUNTRY AND UNITED NATIONS COUNTRY CODES.

Region 1: Latin America

Country	U.N. Country Code
Antigua	28
Argentina	32
Bahamas	44
Barbados	52
Bolivia	68
Brazil	76
Brit. Honduras	84
Brit. Virgin Isls.	92
Cayman Isls.	136
Chile	152
Colombia	170
Costa Rica	188
Dominica	212
Dominican Rep.	214
Ecuador	218
El Salvador	222
Falkland Islands	238
Frnch Guiana	254
Grenada	308
Guadloupe	312
Guatemala	320
Guyana	328
Haiti	332
Honduras	340
Jamaica	388
Martinique	474
Mexico	484

APPENDIX A continued.

Netherlands Antilles	532
Panama Canal Zone	592
Panama	590
Paraguay	600
Peru	604
Puerto Rico	630
St. Kitts-Nevis-Anguilla	658
St. Lucia	662
St. Vincent	670
Surinam	740
Trinidad and Tobago	780
Turks and Caicos Isls.	796
U.S. Virgin Isl.	850
Uruguay	858
Venezuela	862

Region 2: United States

United States	840

Region 3: Canada

Canada	124

Region 4: European Economic Community

Belguim	56
France	250
Germany	280
Italy	380
Luxembourg	442
Netherlands	528

1973 and after add

United Kingdom	826
Ireland	372
Denmark	208

1981 and after add

Greece	300

APPENDIX A continued.

Region 5: Middle East

Afghanistan	4
Bahrain	48
Cyprus	196
Palestine	274
Iran	364
Iraq	368
Israel	376
Jordan	400
Kuwait	414
Lebanon	422
Qatar	634
Saudi Arabia	682
Syria	760
United Arab Emirates	784
Turkey	792

Region 6: Far East

Bangladesh	50
Bhutan	64
Brunei	96
Burma	104
Cambodia	116
Taiwan	158
Fiji	242
French Polynesia	258
Hong Kong	344
India	356
Indonesia	360
Japan	392
Korea	410
Laos	418
Macao	446
Malaysia	458
Maldines	462
Nepal	524
Pakistan	586
Phillipines	608
Singapore	702
Thailand	764
Viet Nam	868

APPENDIX A continued.

Region 7: Africa

Algeria	12
Angola	24
Botswana	72
British Indian Ocean Territory	86
Burundi	108
Cameroon	120
Cape Verde Islands	132
Central African Republic	140
Chad	148
Comoro Island	174
Congo	178
Democratic Republic of Congo	180
Dahomey	204
Egypt	818
Equatorial Guinea	226
Ethiopia	230
Gabon	266
Gambia	270
Ghana	288
Guinea	324
Ivory Coast	384
Kenya	404
Lesotho	426
Liberia	430
Libya	434
Madagascar	450
Malawi	454
Mali	466
Mauritania	478
Mauritius	480
Monaco	492
Morocco	504
Mozambique	508
Namibia	516
Niger	562
Nigeria	566
Portuguese Guinea	624
Reunion	638
Rwanda	646
St. Helena	654
Sao Tome & Principe	678
Senegal	686

APPENDIX A continued.

Region 7: Africa continued.

Seychelles	690
Siena Leone	694
Somalia	706
South Africa	710
Southern Rhodesia	716
Southern Yemen	720
Spanish North Africa	728
Spanish Sahara	732
Sudan	736
Swaziland	748
Togo	768
Tonga	776
Tunisia	788
Uganda	800
Upper Volta	854
Western Samoa	882
Zambia	894
Tanzania	834

Region 8: Non-E.E.C. W. Europe

1981 and after

Austria	40
Finland	246
Iceland	352
Norway	578
Portugal	620
Spain	724
Sweden	752
Switzerland	756

Prior to 1973 add

United Kingdom	826
Denmark	372
Iceland	208

Prior to 1981 add

Greece	300

APPENDIX B
IMPORTS AND EXPORTS BY REGION AND YEAR

TABLE B.1 IMPORTS BY REGION AND YEAR.

Year ---Region---

FREQUENCY PERCENT ROW PCT COL PCT	LATIN AMERICA	UNITED STATES	CANADA	EUROPEAN COMMUNI	MID EAST	FAR EAST	AFRICA	NON-E.C. COUNTRI	TOTAL
1962	204453 0.13 5.53 4.04	315787 0.21 8.54 2.07	464714 0.30 12.57 3.32	1204242 0.78 32.58 1.38	54086 0.04 1.46 2.34	73205 0.05 1.98 1.74	120444 0.08 3.26 2.46	1259439 0.82 34.07 6.10	3696370 2.41
1963	125206 0.08 2.96 2.47	317126 0.21 7.51 2.08	499287 0.32 11.82 3.57	1588523 1.03 37.61 1.82	22334 0.01 0.53 0.97	108919 0.07 2.58 2.59	101450 0.07 2.40 2.07	1460389 0.95 34.58 7.08	4223234 2.75
1964	124162 0.08 3.23 2.45	403398 0.26 10.50 2.64	466592 0.30 12.14 3.33	1613641 1.05 41.99 1.85	18532 0.01 0.48 0.80	100364 0.07 2.61 2.39	122469 0.08 3.19 2.50	993843 0.65 25.86 4.82	3843001 2.50
1965	70066 0.05 1.64 1.38	454671 0.30 10.63 2.98	486323 0.32 11.37 3.48	1644771 1.07 38.44 1.88	35480 0.02 0.83 1.54	101919 0.07 2.38 2.43	103290 0.07 2.41 2.11	1382202 0.90 32.30 6.70	4278721 2.78
1966	105461 0.07 2.46 2.08	455483 0.30 10.63 2.98	564954 0.37 13.19 4.04	1622020 1.06 37.87 1.86	53033 0.03 1.24 2.30	102048 0.07 2.38 2.43	178264 0.12 4.16 3.64	1201788 0.78 28.06 5.83	4283051 2.79
1967	150740 0.10 3.34 2.98	528140 0.34 11.69 3.46	563944 0.37 12.48 4.03	1671800 1.09 36.99 1.91	72762 0.05 1.61 3.15	142555 0.09 3.15 3.39	98551 0.06 2.18 2.01	1291163 0.84 28.57 6.26	4519655 2.94
1968	126163 0.08 2.82 2.49	543471 0.35 12.15 3.56	599773 0.39 13.41 4.29	1842646 1.20 41.20 2.11	36504 0.02 0.82 1.58	90815 0.06 2.03 2.16	71957 0.05 1.61 1.47	1160658 0.76 25.95 5.63	4471987 2.91
1969	129445 0.08 2.41 2.56	653769 0.43 12.16 4.28	586860 0.38 10.91 4.19	2377593 1.55 44.22 2.72	78860 0.05 1.47 3.42	172318 0.11 3.20 4.10	114420 0.07 2.13 2.34	1263892 0.82 23.50 6.13	5377157 3.50
1970	220936 0.14 3.74 4.37	741220 0.48 12.56 4.86	623443 0.41 10.56 4.45	2677285 1.74 45.35 3.07	77805 0.05 1.32 3.37	175728 0.11 2.98 4.18	135815 0.09 2.30 2.78	1251168 0.81 21.19 6.06	5903400 3.84
1971	206078 0.13 3.85 4.07	713540 0.46 13.34 4.68	569229 0.37 10.64 4.07	2401873 1.56 44.89 2.75	96147 0.06 1.80 4.17	159895 0.10 2.99 3.81	135740 0.09 2.54 2.77	1068213 0.70 19.96 5.18	5350720 3.48
1972	507903 0.33 7.99 10.04	736917 0.48 11.59 4.83	670146 0.44 10.54 4.79	2793042 1.82 43.92 3.20	120600 0.08 1.90 5.23	103777 0.07 1.63 2.47	126417 0.08 1.99 2.58	1300954 0.85 20.46 6.31	6359756 4.14
TOTAL	5060758 3.29	15261928 9.93	13994885 9.11	87312245 56.82	2306896 1.50	4199572 2.73	4892291 3.18	20631476 13.43	1.5E+0 100.00

TABLE B.1--continued

Year ---Region---

FREQUENCY PERCENT ROW PCT COL PCT	LATIN AMERICA	UNITED STATES	CANADA	EUROPEAN COMMUNI	MID EAST	FAR EAST	AFRICA	NON-E.C. COUNTRI	TOTAL
1973	368888 0.24 5.60 7.29	859114 0.56 13.05 5.63	735867 0.48 11.18 5.26	3473329 2.26 52.75 3.98	96793 0.06 1.47 4.20	169141 0.11 2.57 4.03	138677 0.09 2.11 2.83	742489 0.48 11.28 3.60	6584298 4.28
1974	231941 0.15 3.47 4.58	804206 0.52 12.02 5.27	714625 0.47 10.68 5.11	3787825 2.47 56.61 4.34	122214 0.08 1.83 5.30	192308 0.13 2.87 4.58	150069 0.10 2.24 3.07	687668 0.45 10.28 3.33	6690856 4.35
1975	287253 0.19 4.01 5.68	751960 0.49 10.49 4.93	752191 0.49 10.50 5.37	3936127 2.56 54.93 4.51	122443 0.08 1.71 5.31	160277 0.10 2.24 3.82	408320 0.27 5.70 8.35	746860 0.49 10.42 3.62	7165431 4.66
1976	224631 0.15 2.54 4.44	780833 0.51 8.85 5.12	843322 0.55 9.55 6.03	5638195 3.67 63.87 6.46	154106 0.10 1.75 6.68	182172 0.12 2.06 4.34	266989 0.17 3.02 5.46	737659 0.48 8.36 3.58	8827907 5.75
1977	237560 0.15 2.38 4.69	1002476 0.65 10.04 6.57	840281 0.55 8.42 6.00	6651845 4.33 66.62 7.62	136574 0.09 1.37 5.92	161850 0.11 1.62 3.85	320693 0.21 3.21 6.56	633429 0.41 6.34 3.07	9984708 6.50
1978	179353 0.12 1.54 3.54	1013566 0.66 8.70 6.64	934372 0.61 8.02 6.68	8260596 5.38 70.89 9.46	26119 0.02 0.22 1.13	240859 0.16 2.07 5.74	330458 0.22 2.84 6.75	666930 0.43 5.72 3.23	11652253 7.58
1979	320152 0.21 2.76 6.33	1011122 0.66 8.71 6.63	716493 0.47 6.17 5.12	7827297 5.09 67.39 8.96	251210 0.16 2.16 10.89	350944 0.23 3.02 8.36	504565 0.33 4.34 10.31	633127 0.41 5.45 3.07	11614910 7.56
1980	733622 0.48 6.40 14.50	1006371 0.65 8.79 6.59	929862 0.61 8.12 6.64	6957028 4.53 60.74 7.97	309856 0.20 2.71 13.43	345762 0.23 3.02 8.23	424548 0.28 3.71 8.68	747178 0.49 6.52 3.62	11454227 7.45
1981	281499 0.18 2.24 5.56	1027166 0.67 8.18 6.73	752660 0.49 6.00 5.38	8559858 5.57 68.20 9.80	222929 0.15 1.78 9.66	528197 0.34 4.21 12.58	535128 0.35 4.26 10.94	644243 0.42 5.13 3.12	12551680 8.17
1982	225246 0.15 1.52 4.45	1141592 0.74 7.70 7.48	679947 0.44 4.59 4.86	10782704 7.02 72.72 12.35	198499 0.13 1.34 8.60	536520 0.35 3.62 12.78	504027 0.33 3.40 10.30	758184 0.49 5.11 3.67	14826719 9.65
TOTAL	5060758 3.29	15261928 9.93	13994885 9.11	87312245 56.82	2306886 1.50	4199572 2.73	4892291 3.18	20631476 13.43	1.5E+08 100.00

TABLE B.2 EXPORTS BY REGION AND YEAR.

Year ---Region---

FREQUENCY PERCENT ROW PCT COL PCT	LATIN AMERICA	UNITED STATES	CANADA	EUROPEAN COMMUNI	MID EAST	FAR EAST	AFRICA	AUSTRALIA - NEW	NON-E.C. COUNTRI	TOTAL
1962	241001 0.16 6.70 1.87	680314 0.46 18.92 3.08	252491 0.17 7.02 3.31	1150762 0.78 32.01 5.31	180860 0.12 5.03 3.12	39976 0.03 1.11 0.08	666741 0.45 18.54 5.31	0 0.00 0.00 0.00	383364 0.26 10.66 2.42	3595509 2.42
1963	292593 0.20 7.22 2.26	862257 0.58 21.28 3.90	289603 0.20 7.15 3.80	1044586 0.70 25.78 4.82	202364 0.14 4.99 3.49	109873 0.07 2.71 0.22	544691 0.37 13.44 4.34	0 0.00 0.00 0.00	706266 0.48 17.43 4.45	4052233 2.73
1964	251533 0.17 6.60 1.95	655332 0.44 17.20 2.96	335177 0.23 8.80 4.40	837640 0.56 21.98 3.87	199569 0.13 5.24 3.44	324385 0.22 8.51 0.65	552185 0.37 14.49 4.40	0 0.00 0.00 0.00	654815 0.44 17.18 4.13	3810636 2.57
1965	353286 0.24 8.36 2.73	687797 0.46 16.27 3.11	318915 0.21 7.54 4.18	1083723 0.73 25.63 5.00	211953 0.14 5.01 3.65	407252 0.27 9.63 0.82	716494 0.48 16.95 5.71	0 0.00 0.00 0.00	448500 0.30 10.61 2.83	4227920 2.85
1966	415045 0.28 9.87 3.21	826008 0.56 19.65 3.74	279004 0.19 6.64 3.66	876962 0.59 20.86 4.05	199278 0.13 4.74 3.44	389069 0.26 9.26 0.78	659072 0.44 15.68 5.25	22123 0.01 0.53 9.17	536913 0.36 12.77 3.38	4203474 2.83
1967	394751 0.27 9.29 3.06	787326 0.53 18.54 3.56	324427 0.22 7.64 4.26	980956 0.66 23.10 4.53	225[illegible]35 0.15 5.30 3.88	354736 0.24 8.35 0.71	630853 0.43 14.85 5.02	30274 0.02 0.71 12.55	518728 0.35 12.21 3.27	4247286 2.86
1968	467740 0.32 11.76 3.62	830399 0.56 20.88 3.76	283434 0.19 7.13 3.72	938688 0.63 23.60 4.33	169765 0.11 4.27 2.93	321192 0.22 8.08 0.65	408446 0.28 10.27 3.25	17237 0.01 0.43 7.15	539870 0.36 13.58 3.40	3976771 2.68
1969	585649 0.39 13.42 4.53	835990 0.56 19.16 3.78	367499 0.25 8.42 4.82	947872 0.64 21.72 4.38	241138 0.16 5.53 4.16	92333 0.06 2.12 0.19	679666 0.46 15.57 5.41	21928 0.01 0.50 9.09	591875 0.40 13.56 3.73	4363950 2.94
1970	660109 0.44 11.51 5.11	876262 0.59 15.28 3.96	338664 0.23 5.90 4.44	893836 0.60 15.58 4.13	271491 0.18 4.73 4.68	1220275 0.82 21.27 2.46	768266 0.52 13.39 6.12	38197 0.03 0.67 15.84	668683 0.45 11.66 4.21	5735783 3.86
1971	606797 0.41 12.05 4.70	841043 0.57 16.70 3.80	261324 0.18 5.19 3.43	856284 0.58 17.00 3.95	282130 0.19 5.60 4.86	1012523 0.68 20.10 2.04	586610 0.40 11.64 4.67	31023 0.02 0.62 12.87	559720 0.38 11.11 3.53	5037454 3.39
1972	666436 0.45 11.11 5.16	933539 0.63 15.56 4.22	271216 0.18 4.52 3.56	1239093 0.83 20.65 5.72	301178 0.20 5.02 5.19	1214955 0.82 20.25 2.45	756953 0.51 12.61 6.03	0 0.00 0.00 0.00	617074 0.42 10.28 3.89	6000444 4.04
TOTAL	12920006 8.70	22111547 14.90	7621297 5.13	21659327 14.59	5801222 3.91	49656018 33.45	12557507 8.46	241142 0.16	15865832 10.69	1.5E+08 100.00

TABLE B.2--continued

Year FREQUENCY PERCENT ROW PCT COL PCT	LATIN AMERICA	UNITED STATES	CANADA	EUROPEAN COMMUNI	MID EAST	FAR EAST	AFRICA	AUSTRALIA - NEW	NON-E.C. COUNTRI	TOTAL
1973	816008 0.55 12.00 6.32	1083603 0.73 15.93 4.90	276828 0.19 4.07 3.63	1020271 0.69 15.00 4.71	329114 0.22 4.84 5.67	1649603 1.11 24.26 3.32	861046 0.58 12.66 6.86	0 0.00 0.00 0.00	764542 0.52 11.24 4.82	6801015 4.58
1974	717809 0.48 10.83 5.56	1012094 0.68 15.26 4.58	258547 0.17 3.90 3.39	1020577 0.69 15.39 4.71	233228 0.16 3.52 4.02	1983042 1.34 29.91 3.99	694829 0.47 10.48 5.53	0 0.00 0.00 0.00	710250 0.48 10.71 4.48	6630376 4.47
1975	742276 0.50 10.13 5.75	1084863 0.73 14.81 4.91	321066 0.22 4.38 4.21	1102276 0.74 15.05 5.09	195264 0.13 2.67 3.37	2479445 1.67 33.85 4.99	590918 0.40 8.07 4.71	0 0.00 0.00 0.00	808321 0.54 11.04 5.09	7324429 4.93
1976	908953 0.61 9.83 7.04	1611716 1.09 17.43 7.29	445010 0.30 4.81 5.84	682478 0.46 7.38 3.15	302208 0.20 3.27 5.21	3762297 2.53 40.68 7.58	616742 0.42 6.67 4.91	0 0.00 0.00 0.00	919968 0.62 9.95 5.80	9249372 6.23
1977	1170252 0.79 11.87 9.06	1229695 0.83 12.48 5.56	402562 0.27 4.08 5.28	914619 0.62 9.28 4.22	452855 0.31 4.59 7.81	3982359 2.68 40.40 8.02	609230 0.41 6.18 4.85	0 0.00 0.00 0.00	1094725 0.74 11.11 6.90	9856297 6.64
1978	1160215 0.78 9.62 8.98	1183822 0.80 9.82 5.35	326316 0.22 2.71 4.28	1103925 0.74 9.15 5.10	371413 0.25 3.08 6.40	6368015 4.29 52.81 12.82	504263 0.34 4.18 4.02	0 0.00 0.00 0.00	1040281 0.70 8.63 6.56	12058250 8.12
1979	1116532 0.75 10.64 8.64	1155936 0.78 11.01 5.23	448474 0.30 4.27 5.88	1110250 0.75 10.58 5.13	353209 0.24 3.37 6.09	4690524 3.16 44.69 9.45	510686 0.34 4.87 4.07	0 0.00 0.00 0.00	1109246 0.75 10.57 6.99	10494857 7.07
1980	1013231 0.68 8.64 7.84	1535402 1.03 13.09 6.94	575283 0.39 4.91 7.55	1248780 0.84 10.65 5.77	339178 0.23 2.89 5.85	5520436 3.72 47.08 11.12	508114 0.34 4.33 4.05	0 0.00 0.00 0.00	986326 0.66 8.41 6.22	11726750 7.90
1981	146236 0.10 1.26 1.13	1939344 1.31 16.67 8.77	561325 0.38 4.83 7.37	1127483 0.81 10.29 5.53	334122 0.23 2.87 5.76	6004616 4.05 51.62 12.09	315957 0.21 2.72 2.52	0 0.00 0.00 0.00	1132948 0.76 9.74 7.14	11632031 7.84
1982	193554 0.13 1.44 1.50	1458805 0.98 10.88 6.60	684132 0.46 5.10 8.98	1408266 0.95 10.50 6.50	405670 0.27 3.03 6.99	7729112 5.21 57.64 15.57	375745 0.25 2.80 2.99	80360 0.05 0.60 33.32	1073417 0.72 8.01 6.77	13409061 9.03
TOTAL	12920006 8.70	22111547 14.90	7621297 5.13	21659327 14.59	5801222 3.91	49656018 33.45	12557507 8.46	241142 0.16	15865832 10.69	1.5E+08 100.00

APPENDIX C
LEVELS AND PATTERNS OF TRADE FOR SELECTED YEARS

TABLE C.1 IMPORTS BY REGION AND PARTNER REGION, YEAR = 1962.

Region ---Partner Region---

FREQUENCY PERCENT ROW PCT CCL PCT	LATIN AM ERICA	UNITED S TATES	CANADA	EUROPEAN COMMUNI	MID EAST	FAR EAST	AFRICA	AUSTRALI A - NEW	NON-E.C. COUNTRI	TOTAL
LATIN AMERICA	0 0.00 0.00 0.00	64055 1.73 31.33 9.52	50877 1.38 24.88 20.98	78181 2.12 38.24 8.37	1155 0.03 0.56 0.54	1170 0.03 0.57 5.10	1660 0.04 0.81 0.17	184 0.00 0.09 0.87	7171 0.19 3.51 1.99	204453 5.53
UNITED STATES	187714 5.08 59.44 68.42	0 0.00 0.00 0.00	108644 2.94 34.40 44.81	11665 0.32 3.69 1.25	586 0.02 0.19 0.28	1940 0.05 0.61 8.46	1398 0.04 0.44 0.15	1298 0.04 0.41 6.14	2542 0.07 0.80 0.71	315787 8.54
CANADA	31589 0.85 6.80 11.51	425616 11.51 91.59 63.28	0 0.00 0.00 0.00	549 0.01 0.12 0.06	2 0.00 0.00 0.00	257 0.01 0.06 1.12	719 0.02 0.15 0.08	0 0.00 0.00 0.00	5982 0.16 1.29 1.66	464714 12.57
EUROPEAN COMMUNI	32500 0.88 2.70 11.85	57399 1.55 4.77 8.53	35545 0.96 2.95 14.66	0 0.00 0.00 0.00	30058 0.81 2.50 14.17	6450 0.17 0.54 28.12	735928 19.91 61.11 76.92	1908 0.05 0.16 9.02	304454 8.24 25.28 84.60	1204242 32.58
MIC EAST	74 0.00 0.14 0.03	3826 0.10 7.07 0.57	59 0.00 0.11 0.02	2789 0.08 5.16 0.30	0 0.00 0.00 0.00	10859 0.29 20.08 47.34	13449 0.36 24.87 1.41	0 0.00 0.00 0.00	23030 0.62 42.58 6.40	54086 1.46
FAR EAST	803 0.02 1.10 0.29	19195 0.52 26.22 2.85	10 0.00 0.01 0.00	17624 0.48 24.07 1.89	7940 0.21 10.85 3.74	0 0.00 0.00 0.00	19262 0.52 26.31 2.01	7120 0.19 9.73 33.66	1251 0.03 1.71 0.35	73205 1.98
AFRICA	24 0.00 0.02 0.01	7146 0.19 5.93 1.06	207 0.01 0.17 0.09	96901 2.62 80.45 10.37	683 0.02 0.57 0.32	24 0.00 0.02 0.10	0 0.00 0.00 0.00	13 0.00 0.01 0.06	15440 0.42 12.82 4.29	120444 3.26
NON-E.C. COUNTRI	21662 0.59 1.72 7.90	95384 2.58 7.57 14.13	47105 1.27 3.74 19.43	726396 19.65 57.68 77.76	171675 4.64 13.63 80.94	2239 0.06 0.18 9.76	184350 4.99 14.64 19.27	10628 0.29 0.84 50.25	0 0.00 0.00 0.00	1259439 34.07
TOTAL	274366 7.42	672621 18.20	242447 6.56	934105 25.27	212105 5.74	22939 0.62	956766 25.88	21151 0.57	359870 9.74	3696370 100.00

TABLE C.2 IMPORTS BY REGION AND PARTNER REGION, YEAR = 1967.

Region ---Partner Region---

FREQUENCY PERCENT ROW PCT COL PCT	LATIN AMERICA	UNITED STATES	CANADA	EUROPEAN COMMUNI	MID EAST	FAR EAST	AFRICA	AUSTRALIA - NEW	NON-E.C. COUNTRI	TOTAL
LATIN AMERICA	0 0.00 0.00 0.00	64532 1.43 42.81 8.13	12707 0.28 8.43 4.81	53954 1.19 35.79 5.89	32 0.00 0.02 0.01	171 0.00 0.11 0.03	1210 0.03 0.80 0.16	0 0.00 0.00 0.00	18134 0.40 12.03 3.84	150740 3.34
UNITED STATES	338522 7.49 64.10 72.89	0 0.00 0.00 0.00	169169 3.74 32.03 64.09	13348 0.30 2.53 1.46	62 0.00 0.01 0.03	1210 0.03 0.23 0.22	1331 0.03 0.25 0.17	1 0.00 0.00 0.00	4497 0.10 0.85 0.95	528140 11.69
CANADA	43165 0.96 7.65 9.29	509247 11.27 90.30 64.12	0 0.00 0.00 0.00	2736 0.06 0.49 0.30	24 0.00 0.00 0.01	452 0.01 0.08 0.08	259 0.01 0.05 0.03	719 0.02 0.13 1.73	7342 0.16 1.30 1.55	563944 12.48
EUROPEAN COMMUNI	33572 0.74 2.01 7.23	51252 1.13 3.07 6.45	8013 0.18 0.48 3.04	0 0.00 0.00 0.00	27758 0.61 1.66 11.27	539920 11.95 32.30 98.92	599419 13.26 35.85 77.40	3828 0.08 0.23 9.22	408038 9.03 24.41 86.39	1671800 36.99
MID EAST	15 0.00 0.02 0.00	16190 0.36 22.25 2.04	260 0.01 0.36 0.10	18829 0.42 25.88 2.05	0 0.00 0.00 0.00	212 0.00 0.29 0.04	17175 0.38 23.60 2.22	8 0.00 0.01 0.02	20073 0.44 27.59 4.25	72762 1.61
FAR EAST	19211 0.43 13.48 4.14	36713 0.81 25.75 4.62	892 0.02 0.63 0.34	36041 0.80 25.28 3.93	1402 0.03 0.98 0.57	0 0.00 0.00 0.00	25634 0.57 17.98 3.31	20621 0.46 14.47 49.67	2041 0.05 1.43 0.43	142555 3.15
AFRICA	3 0.00 0.00 0.00	1446 0.03 1.47 0.18	615 0.01 0.62 0.23	69028 1.53 70.04 7.53	14568 0.32 14.78 5.91	275 0.01 0.28 0.05	0 0.00 0.00 0.00	447 0.01 0.45 1.08	12169 0.27 12.35 2.58	98551 2.18
NON-E.C. COUNTRI	29925 0.66 2.32 6.44	114822 2.54 8.89 14.46	72292 1.60 5.60 27.39	722768 15.99 55.98 78.84	202471 4.48 15.68 82.20	3582 0.08 0.28 0.66	129420 2.86 10.02 16.71	15893 0.35 1.23 38.28	0 0.00 0.00 0.00	1291163 28.57
TOTAL	464413 10.28	794202 17.57	263938 5.84	916704 20.28	246317 5.45	545822 12.08	774448 17.14	41517 0.92	472294 10.45	4519655 100.00

TABLE C.3 IMPORTS BY REGION AND PARTNER REGION, YEAR = 1972.

Region ---Partner Region---

FREQUENCY PERCENT ROW PCT COL PCT	LATIN AMERICA	UNITED STATES	CANADA	EUROPEAN COMMUNI	MID EAST	FAR EAST	AFRICA	AUSTRALIA - NEW	NON-E.C. COUNTRI	TOTAL
LATIN AMERICA	0 0.00 0.00 0.00	96909 1.52 19.08 10.72	55381 0.87 10.90 21.53	266176 4.19 52.41 23.49	26565 0.42 5.23 8.31	618 0.01 0.12 0.04	2416 0.04 0.48 0.28	26 0.00 0.01 0.05	59812 0.94 11.78 9.96	507903 7.99
UNITED STATES	594484 9.35 80.67 82.87	0 0.00 0.00 0.00	110957 1.74 15.06 43.14	13872 0.22 1.88 1.22	953 0.01 0.13 0.30	7213 0.11 0.98 0.48	5485 0.09 0.74 0.63	0 0.00 0.00 0.00	3953 0.06 0.54 0.66	736917 11.59
CANADA	51130 0.80 7.63 7.13	609279 9.58 90.92 67.39	0 0.00 0.00 0.00	3375 0.05 0.50 0.30	165 0.00 0.02 0.05	564 0.01 0.08 0.04	99 0.00 0.01 0.01	0 0.00 0.00 0.00	5534 0.09 0.83 0.92	670146 10.54
EUROPEAN COMMUNI	34406 0.54 1.23 4.80	66329 1.04 2.37 7.34	12192 0.19 0.44 4.74	0 0.00 0.00 0.00	72281 1.14 2.59 22.61	1476775 23.22 52.87 97.73	642229 10.10 22.99 74.15	6207 0.10 0.22 12.16	482623 7.59 17.28 80.39	2793042 43.92
MID EAST	48 0.00 0.04 0.01	2565 0.04 2.13 0.28	384 0.01 0.32 0.15	52087 0.82 43.19 4.60	0 0.00 0.00 0.00	14060 0.22 11.66 0.93	19772 0.31 16.39 2.28	197 0.00 0.16 0.39	31487 0.50 26.11 5.24	120600 1.90
FAR EAST	2904 0.05 2.80 0.40	39136 0.62 37.71 4.33	614 0.01 0.59 0.24	23397 0.37 22.55 2.07	174 0.00 0.17 0.05	0 0.00 0.00 0.00	7745 0.12 7.46 0.89	28117 0.44 27.09 55.10	1690 0.03 1.63 0.28	103777 1.63
AFRICA	571 0.01 0.45 0.08	2040 0.03 1.61 0.23	602 0.01 0.48 0.23	85326 1.34 67.50 7.53	17304 0.27 13.69 5.41	2200 0.03 1.74 0.15	0 0.00 0.00 0.00	3086 0.05 2.44 6.05	15288 0.24 12.09 2.55	126417 1.99
NON-E.C. COUNTRI	33785 0.53 2.60 4.71	87870 1.38 6.75 9.72	77063 1.21 5.92 29.96	688699 10.83 52.94 60.79	202209 3.18 15.54 63.26	9596 0.15 0.74 0.64	188332 2.96 14.48 21.75	13400 0.21 1.03 26.26	0 0.00 0.00 0.00	1300954 20.46
TOTAL	717328 11.28	904128 14.22	257193 4.04	1132932 17.81	319651 5.03	1511026 23.76	866078 13.62	51033 0.80	600387 9.44	6359756 100.00

TABLE C.4 IMPORTS BY REGION AND PARTNER REGION, YEAR = 1973.

Region ---Partner Region---

FREQUENCY PERCENT ROW PCT COL PCT	LATIN AMERICA	UNITED STATES	CANADA	EUROPEAN COMMUNI	MID EAST	FAR EAST	AFRICA	AUSTRALIA - NEW	NON-E.C. COUNTRI	TOTAL
LATIN AMERICA	0 0.00 0.00 0.00	137287 2.09 37.22 12.92	32512 0.49 8.81 12.67	123836 1.88 33.57 13.95	8320 0.13 2.26 2.57	422 0.01 0.11 0.03	3648 0.06 0.99 0.41	327 0.00 0.09 0.43	62536 0.95 16.95 8.08	368888 5.60
UNITED STATES	714025 10.84 83.11 81.28	0 0.00 0.00 0.00	119390 1.81 13.90 46.53	15247 0.23 1.77 1.72	409 0.01 0.05 0.13	3073 0.05 0.36 0.22	5034 0.08 0.59 0.56	0 0.00 0.00 0.00	1936 0.03 0.23 0.25	859114 13.05
CANADA	59169 0.90 8.04 6.74	666448 10.12 90.57 62.71	0 0.00 0.00 0.00	4162 0.06 0.57 0.47	148 0.00 0.02 0.05	743 0.01 0.10 0.05	731 0.01 0.10 0.08	0 0.00 0.00 0.00	4466 0.07 0.61 0.58	735867 11.18
EUROPEAN COMMUNI	58640 0.89 1.69 6.68	147161 2.24 4.24 13.85	89508 1.36 2.58 34.88	0 0.00 0.00 0.00	261056 3.96 7.52 80.71	1387689 21.08 39.95 97.43	793519 12.05 22.85 88.14	42229 0.64 1.22 55.03	693527 10.53 19.97 89.58	3473329 52.75
MID EAST	270 0.00 0.28 0.03	1937 0.03 2.00 0.18	607 0.01 0.63 0.24	53203 0.81 54.97 5.99	0 0.00 0.00 0.00	22467 0.34 23.21 1.58	17441 0.26 18.02 1.94	179 0.00 0.18 0.23	689 0.01 0.71 0.09	96793 1.47
FAR EAST	2282 0.03 1.35 0.26	78224 1.19 46.25 7.36	2009 0.03 1.19 0.78	31892 0.48 18.86 3.59	1063 0.02 0.63 0.33	0 0.00 0.00 0.00	16423 0.25 9.71 1.82	30131 0.46 17.81 39.27	7117 0.11 4.21 0.92	169141 2.57
AFRICA	1001 0.02 0.72 0.11	3419 0.05 2.47 0.32	1187 0.02 0.86 0.46	112168 1.70 80.88 12.64	11743 0.18 8.47 3.63	1787 0.03 1.29 0.13	0 0.00 0.00 0.00	3439 0.05 2.48 4.48	3933 0.06 2.84 0.51	138677 2.11
NON-E.C. COUNTRI	43090 0.65 5.80 4.91	28235 0.43 3.80 2.66	11395 0.17 1.53 4.44	547017 8.31 73.67 61.63	40716 0.62 5.48 12.59	8133 0.12 1.10 0.57	63474 0.96 8.55 7.05	429 0.01 0.06 0.56	0 0.00 0.00 0.00	742489 11.28
TOTAL	878477 13.34	1062711 16.14	256608 3.90	887525 13.48	323455 4.91	1424314 21.63	900270 13.67	76734 1.17	774204 11.76	6584298 100.00

TABLE C.5 IMPORTS BY REGION AND PARTNER REGION, YEAR = 1980.

Region ---Partner Region---

FREQUENCY PERCENT ROW PCT COL PCT	LATIN AMERICA	UNITED STATES	CANADA	EUROPEAN COMMUNI	MID EAST	FAR EAST	AFRICA	AUSTRALIA - NEW	NON-E.C. COUNTRI	TOTAL
LATIN AMERICA	0 0.00 0.00 0.00	464627 4.06 63.33 26.08	99917 0.87 13.62 20.24	135022 1.18 18.40 11.56	1001 0.01 0.14 0.25	354 0.00 0.05 0.01	906 0.01 0.12 0.17	496 0.00 0.07 0.30	31299 0.27 4.27 2.80	733622 6.40
UNITED STATES	767917 6.70 76.31 75.78	0 0.00 0.00 0.00	216521 1.89 21.52 43.87	12207 0.11 1.21 1.04	548 0.00 0.05 0.14	4002 0.03 0.40 0.08	1828 0.02 0.18 0.35	606 0.01 0.06 0.37	2742 0.02 0.27 0.25	1006371 8.79
CANADA	45345 0.40 4.88 4.47	871582 7.61 93.73 48.92	0 0.00 0.00 0.00	3341 0.03 0.36 0.29	459 0.00 0.05 0.11	860 0.01 0.09 0.02	188 0.00 0.02 0.04	0 0.00 0.00 0.00	8087 0.07 0.87 0.72	929862 8.12
EUROPEAN COMMUNI	135991 1.19 1.95 13.42	171121 1.49 2.46 9.60	101164 0.88 1.45 20.50	0 0.00 0.00 0.00	303446 2.65 4.36 75.05	4699136 41.03 67.55 98.19	459146 4.01 6.60 87.43	50981 0.45 0.73 31.15	1036043 9.05 14.89 92.65	6957028 60.74
MID EAST	1703 0.01 0.55 0.17	10911 0.10 3.52 0.61	5120 0.04 1.65 1.04	147023 1.28 47.45 12.58	0 0.00 0.00 0.00	80080 0.70 25.84 1.67	32403 0.28 10.46 6.17	2220 0.02 0.72 1.36	30396 0.27 9.81 2.72	309856 2.71
FAR EAST	2021 0.02 0.58 0.20	172027 1.50 49.75 9.66	13921 0.12 4.03 2.82	39223 0.34 11.34 3.36	3840 0.03 1.11 0.95	0 0.00 0.00 0.00	7115 0.06 2.06 1.35	104297 0.91 30.16 63.73	3318 0.03 0.96 0.30	345762 3.02
AFRICA	22737 0.20 5.36 2.24	58885 0.51 13.87 3.31	40169 0.35 9.46 8.14	233440 2.04 54.99 19.98	61166 0.53 14.41 15.13	1001 0.01 0.24 0.02	0 0.00 0.00 0.00	744 0.01 0.18 0.45	6406 0.06 1.51 0.57	424548 3.71
NON-E.C. COUNTRI	37645 0.33 5.04 3.71	32495 0.28 4.35 1.82	16740 0.15 2.24 3.39	598149 5.22 80.05 51.19	33851 0.30 4.53 8.37	381 0.00 0.05 0.01	23594 0.21 3.16 4.49	4323 0.04 0.58 2.64	0 0.00 0.00 0.00	747178 6.52
TOTAL	1013359 8.85	1781648 15.55	493552 4.31	1168405 10.20	404311 3.53	4785814 41.78	525180 4.59	163667 1.43	1118291 9.76	11454227 100.00

TABLE C.6 IMPORTS BY REGION AND PARTNER REGION, YEAR = 1981.

Region ---Partner Region---

FREQUENCY PERCENT ROW PCT COL PCT	LATIN AMERICA	UNITED STATES	CANADA	EUROPEAN COMMUNI	MID EAST	FAR EAST	AFRICA	AUSTRALIA - NEW	NON-E.C. COUNTRI	TOTAL
LATIN AMERICA	0 0.00 0.00 0.00	130379 1.04 46.32 9.50	51467 0.41 18.28 11.57	71386 0.57 25.36 7.17	2970 0.02 1.06 0.55	386 0.00 0.14 0.01	613 0.00 0.22 0.15	157 0.00 0.06 0.09	24141 0.19 8.58 2.11	281499 2.24
UNITED STATES	714885 5.70 69.60 77.97	0 0.00 0.00 0.00	282548 2.25 27.51 63.53	9334 0.07 0.91 0.94	3057 0.02 0.30 0.57	11527 0.09 1.12 0.18	2749 0.02 0.27 0.66	1517 0.01 0.15 0.91	1549 0.01 0.15 0.14	1027166 8.18
CANADA	44992 0.36 5.98 4.91	700924 5.58 93.13 51.06	0 0.00 0.00 0.00	2357 0.02 0.31 0.24	364 0.00 0.05 0.07	2359 0.02 0.31 0.04	47 0.00 0.01 0.01	0 0.00 0.00 0.00	1617 0.01 0.21 0.14	752660 6.00
EUROPEAN COMMUNI	89988 0.72 1.05 9.81	185458 1.48 2.17 13.51	58854 0.47 0.69 13.23	0 0.00 0.00 0.00	347895 2.77 4.06 64.69	6405413 51.03 74.83 97.71	354666 2.83 4.14 85.44	30221 0.24 0.35 18.06	1087363 8.66 12.70 94.89	8559858 68.2C
MID EAST	320 0.00 0.14 0.03	7102 0.06 3.19 0.52	2111 0.02 0.95 0.47	38552 0.31 17.29 3.87	0 0.00 0.00 0.00	132755 1.06 59.55 2.03	31978 0.25 14.34 7.70	4469 0.04 2.00 2.67	5642 0.04 2.53 0.49	222929 1.78
FAR EAST	2621 0.02 0.50 0.29	240227 1.91 45.48 17.50	21011 0.17 3.98 4.72	72225 0.58 13.67 7.25	41045 0.33 7.77 7.63	0 0.00 0.00 0.00	8744 0.07 1.66 2.11	125075 1.00 23.68 74.73	17249 0.14 3.27 1.51	528197 4.21
AFRICA	12147 0.10 2.27 1.32	76107 0.61 14.22 5.54	13195 0.11 2.47 2.97	327849 2.61 61.27 32.92	91640 0.73 17.12 17.04	2591 0.02 0.48 0.04	0 0.00 0.00 0.00	3232 0.03 0.60 1.93	8367 0.07 1.56 0.73	535128 4.26
NON-E.C. COUNTRI	51937 0.41 8.06 5.66	32595 0.26 5.06 2.37	15548 0.12 2.41 3.50	474198 3.78 73.61 47.61	50784 0.40 7.88 9.44	196 0.00 0.03 0.00	16291 0.13 2.53 3.92	2694 0.02 0.42 1.61	0 0.00 0.00 0.00	644243 5.13
TOTAL	916890 7.30	1372792 10.94	444734 3.54	995901 7.93	537755 4.28	6555227 52.23	415088 3.31	167365 1.33	1145928 9.13	12551680 100.00

TABLE C.7 IMPORTS BY REGION AND PARTNER REGION, YEAR = 1982.

Region ---Partner Region---

FREQUENCY PERCENT ROW PCT COL PCT	LATIN AMERICA	UNITED STATES	CANADA	EUROPEAN COMMUNI	MID EAST	FAR EAST	AFRICA	AUSTRALIA - NEW	NON-E.C. COUNTRI	TOTAL
LATIN AMERICA	0 0.00 0.00 0.00	122527 0.83 54.40 10.21	38070 0.26 16.90 7.68	47130 0.32 20.92 4.36	1325 0.01 0.59 0.19	1605 0.01 0.71 0.02	246 0.00 0.11 0.07	185 0.00 0.08 0.10	14158 0.10 6.29 1.24	225246 1.52
UNITED STATES	777124 5.24 68.07 77.92	0 0.00 0.00 0.00	337564 2.28 29.57 68.10	16849 0.11 1.48 1.56	1815 0.01 0.16 0.26	2216 0.01 0.19 0.03	2944 0.02 0.26 0.79	1014 0.01 0.09 0.53	2066 0.01 0.18 0.18	1141592 7.70
CANADA	36214 0.24 5.33 3.63	633560 4.27 93.18 52.79	0 0.00 0.00 0.00	3054 0.02 0.45 0.28	1362 0.01 0.20 0.19	1251 0.01 0.18 0.01	339 0.00 0.05 0.09	324 0.00 0.05 0.17	3843 0.03 0.57 0.34	679947 4.59
EUROPEAN COMMUNI	105328 0.71 0.98 10.56	241163 1.63 2.24 20.09	83854 0.57 0.78 16.92	0 0.00 0.00 0.00	392776 2.65 3.64 55.49	8509101 57.39 78.91 98.47	317831 2.14 2.95 85.17	35803 0.24 0.33 18.55	1096848 7.40 10.17 96.40	10782704 72.72
MID EAST	1805 0.01 0.91 0.18	5735 0.04 2.89 0.48	1634 0.01 0.82 0.33	23386 0.16 11.78 2.17	0 0.00 0.00 0.00	124081 0.84 62.51 1.44	32141 0.22 16.19 8.61	3631 0.02 1.83 1.88	6086 0.04 3.07 0.53	198499 1.34
FAR EAST	4630 0.03 0.86 0.46	132260 0.89 24.65 11.02	12284 0.08 2.29 2.48	91967 0.62 17.14 8.52	136432 0.92 25.43 19.28	0 0.00 0.00 0.00	6163 0.04 1.15 1.65	146963 0.99 27.39 76.15	5821 0.04 1.08 0.51	536520 3.62
AFRICA	16715 0.11 3.32 1.68	30804 0.21 6.11 2.57	1798 0.01 0.36 0.36	322244 2.17 63.93 29.84	119016 0.80 23.61 16.81	1612 0.01 0.32 0.02	0 0.00 0.00 0.00	2805 0.02 0.56 1.45	9033 0.06 1.79 0.79	504027 3.40
NON-E.C. COUNTRI	55576 0.37 7.33 5.57	34094 0.23 4.50 2.84	20464 0.14 2.70 4.13	575360 3.88 75.89 53.27	55085 0.37 7.27 7.78	1850 0.01 0.24 0.02	13492 0.09 1.78 3.62	2263 0.02 0.30 1.17	0 0.00 0.00 0.00	758184 5.11
TOTAL	997392 6.73	1200143 8.09	495668 3.34	1079990 7.28	707811 4.77	8641716 58.28	373156 2.52	192988 1.30	1137855 7.67	14826719 100.00

TABLE C.8 EXPORTS BY REGION AND PARTNER REGION, YEAR = 1962.

Region ---Partner Region---

FREQUENCY PERCENT ROW PCT COL PCT	LATIN AMERICA	UNITED STATES	CANADA	EUROPEAN COMMUNI	MID EAST	FAR EAST	AFRICA	AUSTRALIA - NEW	NON-E.C. COUNTRI	TOTAL
LATIN AMERICA	0 0.00 0.00 0.00	188041 5.23 78.02 60.54	5287 0.15 2.19 1.34	23581 0.66 9.78 2.55	74 0.00 0.03 0.10	2184 0.06 0.91 3.78	24 0.00 0.01 0.01	45 0.00 0.02 0.59	21765 0.61 9.03 1.77	241001 6.70
UNITED STATES	95974 2.67 14.11 31.06	0 0.00 0.00 0.00	382265 10.63 56.19 96.98	63409 1.76 9.32 6.87	6156 0.17 0.90 8.32	15227 0.42 2.24 26.35	12694 0.35 1.87 4.33	3151 0.09 0.46 41.16	101438 2.82 14.91 8.27	680314 18.92
CANADA	64877 1.80 25.69 21.00	100942 2.81 39.98 32.50	0 0.00 0.00 0.00	37487 1.04 14.85 4.06	0 0.00 0.00 0.00	4 0.00 0.00 0.01	207 0.01 0.08 0.07	0 0.00 0.00 0.00	48974 1.36 19.40 3.99	252491 7.02
EUROPEAN COMMUNI	126043 3.51 10.95 40.80	14033 0.39 1.22 4.52	2829 0.08 0.25 0.72	0 0.00 0.00 0.00	9378 0.26 0.81 12.68	18077 0.50 1.57 31.28	245007 6.81 21.29 83.66	2813 0.08 0.24 36.74	732582 20.37 63.66 59.73	1150762 32.01
MID EAST	606 0.02 0.34 0.20	115 0.00 0.06 0.04	2 0.00 0.00 0.00	24011 0.67 13.28 2.60	0 0.00 0.00 0.00	506 0.01 0.28 0.88	5 0.00 0.00 0.00	0 0.00 0.00 0.00	155615 4.33 86.04 12.69	180860 5.03
FAR EAST	2853 0.08 7.14 0.92	1178 0.03 2.95 0.38	41 0.00 0.10 0.01	12395 0.34 31.01 1.34	10859 0.30 27.16 14.68	0 0.00 0.00 0.00	10303 0.29 25.77 3.52	212 0.01 0.53 2.77	2135 0.06 5.34 0.17	39976 1.11
AFRICA	4829 0.13 0.72 1.56	990 0.03 0.15 0.32	687 0.02 0.10 0.17	461079 12.82 69.15 49.95	13449 0.37 2.02 18.18	20802 0.58 3.12 35.99	0 0.00 0.00 0.00	975 0.03 0.15 12.74	163930 4.56 24.59 13.37	666741 18.54
NON-E.C. COUNTRI	13780 0.38 3.59 4.46	5298 0.15 1.38 1.71	3048 0.08 0.80 0.77	301107 8.37 78.54 32.62	34050 0.95 8.88 46.03	996 0.03 0.26 1.72	24625 0.68 6.42 8.41	460 0.01 0.12 6.01	0 0.00 0.00 0.00	383364 10.66
TOTAL	308962 8.59	310597 8.64	394159 10.96	923069 25.67	73966 2.06	57796 1.61	292865 8.15	7656 0.21	1226439 34.11	3595509 100.00

TABLE C.9 EXPORTS BY REGION AND PARTNER REGION, YEAR = 1967.

Region ---Partner Region---

FREQUENCY PERCENT ROW PCT COL PCT	LATIN AMERICA	UNITED STATES	CANADA	EUROPEAN COMMUNI	MID EAST	FAR EAST	AFRICA	AUSTRALIA - NEW	NON-E.C. COUNTRI	TOTAL
LATIN AMERICA	0 0.00 0.00 0.00	338522 7.97 85.76 64.10	2933 0.07 0.74 0.59	18516 0.44 4.69 1.40	0 0.00 0.00 0.00	2315 0.05 0.59 1.91	0 0.00 0.00 0.00	85 0.00 0.02 0.75	32380 0.76 8.20 2.66	394751 9.29
UNITED STATES	90524 2.13 11.50 35.39	0 0.00 0.00 0.00	486467 11.45 61.79 98.20	44277 1.04 5.62 3.34	2184 0.05 0.28 2.11	41739 0.98 5.30 34.51	8856 0.21 1.12 4.62	7418 0.17 0.94 65.48	105861 2.49 13.45 8.71	787326 18.54
CANADA	70899 1.67 21.85 27.72	169169 3.98 52.14 32.03	0 0.00 0.00 0.00	6333 0.15 1.95 0.48	755 0.02 0.23 0.73	46 0.00 0.01 0.04	3955 0.09 1.22 2.06	264 0.01 0.08 2.33	73006 1.72 22.50 6.01	324427 7.64
EUROPEAN COMMUNI	58776 1.38 5.99 22.98	13348 0.31 1.36 2.53	3122 0.07 0.32 0.63	0 0.00 0.00 0.00	33782 0.80 3.44 32.58	36695 0.86 3.74 30.34	135935 3.20 13.86 70.84	2152 0.05 0.22 19.00	697146 16.41 71.07 57.35	980956 23.10
MID EAST	0 0.00 0.00 0.00	62 0.00 0.03 0.01	41 0.00 0.02 0.01	24454 0.58 10.86 1.85	0 0.00 0.00 0.00	1205 0.03 0.53 1.00	3473 0.08 1.54 1.81	210 0.00 0.09 1.85	195790 4.61 86.93 16.11	225235 5.30
FAR EAST	538 0.01 0.15 0.21	1210 0.03 0.34 0.23	44 0.00 0.01 0.01	334610 7.88 94.33 25.26	10486 0.25 2.96 10.11	0 0.00 0.00 0.00	5396 0.13 1.52 2.81	66 0.00 0.02 0.58	2386 0.06 0.67 0.20	354736 8.35
AFRICA	16645 0.39 2.64 6.51	1331 0.03 0.21 0.25	94 0.00 0.01 0.02	458578 10.80 72.69 34.62	33550 0.79 5.32 32.35	17129 0.40 2.72 14.16	0 0.00 0.00 0.00	137 0.00 0.02 1.21	103389 2.43 16.39 8.50	630853 14.85
AUSTRALIA - NEW	147 0.00 0.49 0.06	1 0.00 0.00 0.00	13 0.00 0.04 0.00	1117 0.03 3.69 0.08	172 0.00 0.57 0.17	19607 0.46 64.77 16.21	3480 0.08 11.50 1.81	0 0.00 0.00 0.00	5737 0.14 18.95 0.47	30274 0.71
NON-E.C. COUNTRI	18241 0.43 3.52 7.13	4497 0.11 0.87 0.85	2683 0.06 0.52 0.54	436555 10.28 84.16 32.96	22770 0.54 4.39 21.96	2196 0.05 0.42 1.82	30789 0.72 5.94 16.05	997 0.02 0.19 8.80	0 0.00 0.00 0.00	518728 12.21
TOTAL	255770 6.02	528140 12.43	495397 11.66	1324440 31.18	103699 2.44	120932 2.85	191884 4.52	11329 0.27	1215695 28.62	4247286 100.00

TABLE C.10 EXPORTS BY REGION AND PARTNER REGION, YEAR = 1972.

Region ---Partner Region---

FREQUENCY PERCENT ROW PCT COL PCT	LATIN AMERICA	UNITED STATES	CANADA	EUROPEAN COMMUNI	MID EAST	FAR EAST	AFRICA	AUSTRALIA - NEW	NON-E.C. COUNTRI	TOTAL
LATIN AMERICA	0 0.00 0.00 0.00	594484 9.91 89.20 80.67	1488 0.02 0.22 0.24	38082 0.63 5.71 1.58	403 0.01 0.06 0.30	2901 0.05 0.44 3.48	571 0.01 0.09 0.25	64 0.00 0.01 0.76	28443 0.47 4.27 2.34	666436 11.11
UNITED STATES	107354 1.79 11.50 18.82	0 0.00 0.00 0.00	609279 10.15 65.27 98.19	75134 1.25 8.05 3.12	1785 0.03 0.19 1.32	40727 0.68 4.36 48.80	10892 0.18 1.17 4.86	4081 0.07 0.44 48.34	84287 1.40 9.03 6.94	933539 15.56
CANADA	98635 1.64 36.37 17.30	110957 1.85 40.91 15.06	0 0.00 0.00 0.00	1304 0.02 0.48 0.05	941 0.02 0.35 0.70	630 0.01 0.23 0.75	1652 0.03 0.61 0.74	49 0.00 0.02 0.58	57048 0.95 21.03 4.70	271216 4.52
EUROPEAN COMMUNI	291002 4.85 23.49 51.03	13872 0.23 1.12 1.88	3375 0.06 0.27 0.54	0 0.00 0.00 0.00	48963 0.82 3.95 36.28	30557 0.51 2.47 36.61	167028 2.78 13.48 74.51	2307 0.04 0.19 27.32	681989 11.37 55.04 56.18	1239093 20.65
MID EAST	16646 0.28 5.53 2.92	953 0.02 0.32 0.13	165 0.00 0.05 0.03	74327 1.24 24.68 3.09	0 0.00 0.00 0.00	889 0.01 0.30 1.07	5222 0.09 1.73 2.33	592 0.01 0.20 7.01	202384 3.37 67.20 16.67	301178 5.02
FAR EAST	81 0.00 0.01 0.01	7213 0.12 0.59 0.98	564 0.01 0.05 0.09	1178317 19.64 96.98 48.94	16926 0.28 1.39 12.54	0 0.00 0.00 0.00	3772 0.06 0.31 1.68	525 0.01 0.04 6.22	7557 0.13 0.62 0.62	1214955 20.25
AFRICA	695 0.01 0.09 0.12	5485 0.09 0.72 0.74	99 0.00 0.01 0.02	557568 9.29 73.66 23.16	34566 0.58 4.57 25.61	6017 0.10 0.79 7.21	0 0.00 0.00 0.00	329 0.01 0.04 3.90	152194 2.54 20.11 12.54	756953 12.61
NON-E.C. COUNTRI	55888 0.93 9.06 9.80	3953 0.07 0.64 0.54	5534 0.09 0.90 0.89	483027 8.05 78.28 20.06	31390 0.52 5.09 23.26	1743 0.03 0.28 2.09	35043 0.58 5.68 15.63	496 0.01 0.08 5.87	0 0.00 0.00 0.00	617074 10.28
TOTAL	570301 9.50	736917 12.28	620504 10.34	2407759 40.13	134974 2.25	83464 1.39	224180 3.74	8443 0.14	1213902 20.23	6000444 100.00

TABLE C.11 EXPORTS BY REGION AND PARTNER REGION, YEAR = 1973.

Region ---Partner Region---

FREQUENCY PERCENT ROW PCT COL PCT	LATIN AMERICA	UNITED STATES	CANADA	EUROPEAN COMMUNI	MID EAST	FAR EAST	AFRICA	AUSTRALIA - NEW	NON-E.C. COUNTRI	TOTAL
LATIN AMERICA	0 0.00 0.00 0.00	714029 10.50 87.50 83.05	783 0.01 0.10 0.12	38112 0.56 4.67 1.06	2353 0.03 0.29 1.99	2563 0.04 0.31 1.86	5890 0.09 0.72 2.39	132 0.00 0.02 0.77	52146 0.77 6.39 7.05	816008 12.00
UNITED STATES	129857 1.91 11.98 32.47	0 0.00 0.00 0.00	666448 9.80 61.50 98.37	164846 2.42 15.21 4.57	2812 0.04 0.26 2.38	76013 1.12 7.01 55.24	9959 0.15 0.92 4.03	10873 0.16 1.00 63.09	22795 0.34 2.10 3.08	1083603 15.93
CANADA	53456 0.79 19.31 13.37	119390 1.76 43.13 13.89	0 0.00 0.00 0.00	81912 1.20 29.59 2.27	898 0.01 0.32 0.76	2058 0.03 0.74 1.50	1568 0.02 0.57 0.64	1727 0.03 0.62 10.02	15819 0.23 5.71 2.14	276828 4.07
EUROPEAN COMMUNI	156146 2.30 15.30 39.04	15247 0.22 1.49 1.77	4162 0.06 0.41 0.61	0 0.00 0.00 0.00	56678 0.83 5.56 47.92	32896 0.48 3.22 23.91	206350 3.03 20.23 83.60	2669 0.04 0.26 15.49	546123 8.03 53.53 73.83	1020271 15.00
MID EAST	9287 0.14 2.82 2.32	409 0.01 0.12 0.05	148 0.00 0.04 0.02	265948 3.91 80.81 7.38	0 0.00 0.00 0.00	2460 0.04 0.75 1.79	4506 0.07 1.37 1.83	658 0.01 0.20 3.82	45698 0.67 13.89 6.18	329114 4.84
FAR EAST	3367 0.05 0.20 0.84	3073 0.05 0.19 0.36	745 0.01 0.05 0.11	1607258 23.63 97.43 44.59	19622 0.29 1.19 16.59	0 0.00 0.00 0.00	3431 0.05 0.21 1.39	111 0.00 0.01 0.64	11996 0.18 0.73 1.62	1649603 24.26
AFRICA	3574 0.05 0.42 0.89	5722 0.08 0.66 0.67	731 0.01 0.08 0.11	754815 11.10 87.66 20.94	35546 0.52 4.13 30.05	14580 0.21 1.69 10.60	0 0.00 0.00 0.00	905 0.01 0.11 5.25	45173 0.66 5.25 6.11	861046 12.66
NON-E.C. COUNTRI	44233 0.65 5.79 11.06	1936 0.03 0.25 0.23	4466 0.07 0.58 0.66	691232 10.16 90.41 19.18	378 0.01 0.05 0.32	7025 0.10 0.92 5.11	15112 0.22 1.98 6.12	160 0.00 0.02 0.93	0 0.00 0.00 0.00	764542 11.24
TOTAL	399920 5.88	859806 12.64	677483 9.96	3604123 52.99	118287 1.74	137595 2.02	246816 3.63	17235 0.25	739750 10.88	6801015 100.00

TABLE C.12 EXPORTS BY REGION AND PARTNER REGION, YEAR = 1980.

Region ---Partner Region---

FREQUENCY PERCENT ROW PCT COL PCT	LATIN AMERICA	UNITED STATES	CANADA	EUROPEAN COMMUNI	MID EAST	FAR EAST	AFRICA	AUSTRALIA - NEW	NON-E.C. COUNTRI	TOTAL
LATIN AMERICA	0	774963	48221	114705	17392	818	22645	0	34487	1013231
	0.00	6.61	0.41	0.98	0.15	0.01	0.19	0.00	0.29	8.64
	0.00	76.48	4.76	11.32	1.72	0.08	2.23	0.00	3.40	
	0.00	76.23	7.44	1.57	4.36	0.32	5.06	0.00	4.55	
UNITED STATES	478270	0	593237	157862	13815	183905	70204	5609	32500	1535402
	4.08	0.00	5.06	1.35	0.12	1.57	0.60	0.05	0.28	13.09
	31.15	0.00	38.64	10.28	0.90	11.98	4.57	0.37	2.12	
	53.96	0.00	91.48	2.16	3.46	71.72	15.67	52.09	4.29	
CANADA	196597	212112	0	94217	5515	17043	36325	1327	12147	575283
	1.68	1.81	0.00	0.80	0.05	0.15	0.31	0.01	0.10	4.91
	34.17	36.87	0.00	16.38	0.96	2.96	6.31	0.23	2.11	
	22.18	20.86	0.00	1.29	1.38	6.65	8.11	12.32	1.60	
EUROPEAN COMMUNI	186394	14875	2570	0	138828	34831	280754	2707	587821	1248780
	1.59	0.13	0.02	0.00	1.18	0.30	2.39	0.02	5.01	10.65
	14.93	1.19	0.21	0.00	11.12	2.79	22.48	0.22	47.07	
	21.03	1.46	0.40	0.00	34.77	13.58	62.68	25.14	77.57	
MID EAST	1002	1907	870	280499	0	3996	9814	274	40816	339178
	0.01	0.02	0.01	2.39	0.00	0.03	0.08	0.00	0.35	2.89
	0.30	0.56	0.26	82.70	0.00	1.18	2.89	0.08	12.03	
	0.11	0.19	0.13	3.84	0.00	1.56	2.19	2.54	5.39	
FAR EAST	12053	8507	2013	5321034	137467	0	5076	587	33699	5520436
	0.10	0.07	0.02	45.38	1.17	0.00	0.04	0.01	0.29	47.08
	0.22	0.15	0.04	96.39	2.49	0.00	0.09	0.01	0.61	
	1.36	0.84	0.31	72.86	34.42	0.00	1.13	5.45	4.45	
AFRICA	115	1312	235	415245	62491	12333	0	105	16278	508114
	0.00	0.01	0.00	3.54	0.53	0.11	0.00	0.00	0.14	4.33
	0.02	0.26	0.05	81.72	12.30	2.43	0.00	0.02	3.20	
	0.01	0.13	0.04	5.69	15.65	4.81	0.00	0.98	2.15	
NON-E.C. COUNTRI	11956	2992	1367	919474	23817	3496	23065	159	0	986326
	0.10	0.03	0.01	7.84	0.20	0.03	0.20	0.00	0.00	8.41
	1.21	0.30	0.14	93.22	2.41	0.35	2.34	0.02	0.00	
	1.35	0.29	0.21	12.59	5.96	1.36	5.15	1.48	0.00	
TOTAL	886387	1016668	648513	7303036	399325	256422	447883	10768	757748	11726750
	7.56	8.67	5.53	62.28	3.41	2.19	3.82	0.09	6.46	100.00

TABLE C.13 EXPORTS BY REGION AND PARTNER REGION, YEAR = 1981.

Region ---Partner Region---

FREQUENCY PERCENT ROW PCT COL PCT	LATIN AMERICA	UNITED STATES	CANADA	EUROPEAN COMMUNI	MID EAST	FAR EAST	AFRICA	AUSTRALIA - NEW	NON-E.C. COUNTRI	TOTAL
LATIN AMERICA	0 0.00 0.00 0.00	62985 0.54 43.07 16.35	1195 0.01 0.82 0.17	58797 0.51 40.21 0.78	2582 0.02 1.77 0.94	733 0.01 0.50 0.16	6785 0.06 4.64 1.07	0 0.00 0.00 0.00	13159 0.11 9.00 1.99	146236 1.26
UNITED STATES	627771 5.40 32.37 67.31	0 0.00 0.00 0.00	700924 6.03 36.14 98.88	205134 1.76 10.58 2.71	9892 0.09 0.51 3.61	253688 2.18 13.08 57.09	96600 0.83 4.98 15.25	13292 0.11 0.69 56.73	32043 0.28 1.65 4.84	1939344 16.67
CANADA	164796 1.42 29.36 17.67	286047 2.46 50.96 74.26	0 0.00 0.00 0.00	47750 0.41 8.51 0.63	3986 0.03 0.71 1.46	24654 0.21 4.39 5.55	12184 0.10 2.17 1.92	5822 0.05 1.04 24.85	16086 0.14 2.87 2.43	561325 4.83
EUROPEAN COMMUNI	114968 0.99 9.60 12.33	11420 0.10 0.95 2.96	2357 0.02 0.20 0.33	0 0.00 0.00 0.00	103974 0.89 8.68 37.99	77703 0.67 6.49 17.49	429122 3.69 35.84 67.75	2993 0.03 0.25 12.77	454946 3.91 37.99 68.74	1197483 10.29
MID EAST	11551 0.10 3.46 1.24	3436 0.03 1.03 0.89	364 0.00 0.11 0.05	125973 1.08 37.70 1.66	0 0.00 0.00 0.00	71959 0.62 21.54 16.19	64907 0.56 19.43 10.25	382 0.00 0.11 1.63	55550 0.48 16.63 8.39	334122 2.87
FAR EAST	246 0.00 0.00 0.03	17148 0.15 0.29 4.45	2369 0.02 0.04 0.33	5813611 49.98 96.82 76.81	85514 0.74 1.42 31.24	0 0.00 0.00 0.00	4936 0.04 0.08 0.78	663 0.01 0.01 2.83	80129 0.69 1.33 12.11	6004616 51.62
AFRICA	16 0.00 0.01 0.00	666 0.01 0.21 0.17	47 0.00 0.01 0.01	241697 2.08 76.50 3.19	62401 0.54 19.75 22.80	1175 0.01 0.37 0.26	0 0.00 0.00 0.00	0 0.00 0.00 0.00	9955 0.09 3.15 1.50	315957 2.72
NON-E.C. COUNTRI	13330 0.11 1.18 1.43	3520 0.03 0.31 0.91	1617 0.01 0.14 0.23	1075500 9.25 94.93 14.21	5356 0.05 0.47 1.96	14460 0.12 1.28 3.25	18888 0.16 1.67 2.98	277 0.00 0.02 1.18	0 0.00 0.00 0.00	1132948 9.74
TOTAL	932678 8.02	385222 3.31	708873 6.09	7568462 65.07	273705 2.35	444372 3.82	633422 5.45	23429 0.20	661868 5.69	11632031 100.00

TABLE C.14 EXPORTS BY REGION AND PARTNER REGION, YEAR =1982.

Region FREQUENCY PERCENT ROW PCT COL PCT	---Partner Region--- LATIN AMERICA	UNITED STATES	CANADA	EUROPEAN COMMUNI	MID EAST	FAR EAST	AFRICA	AUSTRALIA - NEW	NON-E.C. COUNTRI	TOTAL
LATIN AMERICA	0 0.00 0.00 0.00	60312 0.45 31.16 13.81	1438 0.01 0.74 0.22	73876 0.55 38.17 0.78	16840 0.13 8.70 7.29	1720 0.01 0.89 0.41	21805 0.16 11.27 2.69	0 0.00 0.00 0.00	17563 0.13 9.07 2.35	193554 1.44
UNITED STATES	326368 2.43 22.37 53.09	0 0.00 0.00 0.00	633560 4.72 43.43 98.20	221626 1.65 15.19 2.34	13723 0.10 0.94 5.94	168866 1.26 11.58 40.04	53340 0.40 3.66 6.57	6907 0.05 0.47 48.26	34415 0.26 2.36 4.61	1458805 10.88
CANADA	165846 1.24 24.24 26.98	349642 2.61 51.11 80.07	0 0.00 0.00 0.00	94816 0.71 13.86 1.00	6418 0.05 0.94 2.78	15777 0.12 2.31 3.74	21594 0.16 3.16 2.66	1793 0.01 0.26 12.53	28246 0.21 4.13 3.78	684132 5.10
EUROPEAN COMMUNI	98755 0.74 7.01 16.07	15865 0.12 1.13 3.63	3054 0.02 0.22 0.47	0 0.00 0.00 0.00	87610 0.65 6.22 37.91	63486 0.47 4.51 15.05	574985 4.29 40.83 70.83	4358 0.03 0.31 30.45	560153 4.18 39.78 75.06	1408266 10.50
MID EAST	14829 0.11 3.66 2.41	2135 0.02 0.53 0.49	1362 0.01 0.34 0.21	120970 0.90 29.82 1.28	0 0.00 0.00 0.00	117143 0.87 28.88 27.78	121593 0.91 29.97 14.98	177 0.00 0.04 1.24	27461 0.20 6.77 3.68	405670 3.03
FAR EAST	5031 0.04 0.07 0.82	2080 0.02 0.03 0.48	1251 0.01 0.02 0.19	7643079 57.00 98.89 80.56	9500 0.07 0.12 4.11	0 0.00 0.00 0.00	1639 0.01 0.02 0.20	704 0.01 0.01 4.92	65828 0.49 0.85 8.82	7729112 57.64
AFRICA	17 0.00 0.00 0.00	2923 0.02 0.78 0.67	339 0.00 0.09 0.05	267046 1.99 71.07 2.81	90471 0.67 24.08 39.14	3525 0.03 0.94 0.84	0 0.00 0.00 0.00	18 0.00 0.00 0.13	11406 0.09 3.04 1.53	375745 2.80
AUSTRALIA - NEW	73 0.00 0.09 0.01	345 0.00 0.43 0.08	324 0.00 0.40 0.05	21701 0.16 27.00 0.23	3564 0.03 4.44 1.54	48745 0.36 60.66 11.56	4403 0.03 5.48 0.54	0 0.00 0.00 0.00	1205 0.01 1.50 0.16	80360 0.60
NON-E.C. COUNTRI	3795 0.03 0.35 0.62	3370 0.03 0.31 0.77	3843 0.03 0.36 0.60	1044175 7.79 97.28 11.01	2996 0.02 0.28 1.30	2461 0.02 0.23 0.58	12422 0.09 1.16 1.53	355 0.00 0.03 2.48	0 0.00 0.00 0.00	1073417 8.01
TOTAL	614714 4.58	436672 3.26	645171 4.81	9487289 70.75	231122 1.72	421723 3.15	811781 6.05	14312 0.11	746277 5.57	13409061 100.00

APPENDIX D
DERIVATION OF THE PRODUCT DEMAND FUNCTIONAL FORM FROM THE CRES MARKET DEMAND

APPENDIX D

DERIVATION OF THE PRODUCT DEMAND FUNCTIONAL FORM FROM THE CRES MARKET DEMAND

CRES Market Demand

$$X(i.) = \{ \Sigma_j \beta(ij) X(ij)^{\alpha(ij)} \}^{(1/\alpha(i.))}$$

let

$$\phi = \Sigma_j \beta(ij) X(ij)^{\alpha(ij)}$$

Therefore

$$X(i.) = \phi^{(1/\alpha(i.))}$$

$$\partial X(i.) / \partial X(ij) = 1 /\{ \alpha(i.) X(i.) X(i.)^{(-\alpha(i.))} \alpha(ij) \beta(ij) X(ij)^{(\alpha(ij)-1)} \}$$

The first-order conditions for optimum product mix in the ith market imply:

$$P(i.) = P(ij) /\{ \partial X(i.) / \partial X(ij) \}$$

Therefore

$$P(i.) = P(ij) /\{ 1 /(\alpha(i.) X(i.) X(i.)^{(-\alpha(i.))} \alpha(ij) \beta(ij) X(ij)^{(\alpha(ij)-1)}) \}$$

$$P(i.) =\{ P(ij) \alpha(i.) X(i.)^{(\alpha(i.))} X(ij) \} / \{ X(i.) \alpha(ij) \beta(ij) X(ij)^{\alpha(ij)} \}$$

$$P(i.) = P(ij) \alpha(i.) X(i.)^{-1} X(i.)^{(\alpha(i.))}$$

$\beta(ij)^{-1}\ \alpha(ij)^{-1}\ X(ij)^{-\alpha(ij)}\ X(ij)$

$X(ij)^{(\alpha(ij)-1)} = \{P(ij) / P(i.)\}\ \{\alpha(i.) / \alpha(ij)\ \beta(ij)\}\ \{X(i.)^{(\alpha(i.)-1)}\}$

$X(ij) = \{P(ij) / P(i.)\}\ \{\alpha(i.) / \alpha(ij)\ \beta(ij)\}^{(1/(\alpha(ij)-1))}\ \{X(i.)^{((\alpha(i.)-1)/(\alpha(ij)-1))}\}$

APPENDIX E
TARIFF LEVELS USED IN THE TRADE MODEL

APPENDIX E

TARIFF LEVELS USED IN ESTIMATION OF MODEL, BY IMPORTING REGION

Latin America

1962-1982 All tariff levels = 0

U.S.

1962-1979 All tariff levels = .182
1980-1982 All tariff levels = .170

Canada

1962-1982 All tariff levels = .130

E.E.C.

Vegetable Product	1962-1972	1973-1979	1980-1982
Latin American	.137	.170	.200
U.S.	.137	.170	.200
Canadian	.137	.170	.200
Middle Eastern	.080	.100	.200
Far Eastern	.137	.170	.200
African	.080	.100	.200
Non-E.E.C. W. European	.137	.170	.200

Middle East

1962-1982 All tariff levels = 0

Far East

1962-1982 All tariff levels = .100

Africa

1962-1982 All tariff levels = 0

Non-E.E.C. W. Europe

1962-1982 All tariff levels = .090

APPENDIX F
PRINCIPAL COMPONENT ANALYSIS

APPENDIX F
PRINCIPAL COMPONENT ANALYSIS

21 OBSERVATIONS
25 VARIABLES

SIMPLE STATISTICS

	POP1	GDP1	PRD1	POP2	GDP2	PRD2	POP3	GDP3	PRD3
MEAN	317.108	67.3182	60908625	209.548	1424.78	37474568	21.7700	136.788	4057902
ST DEV	93.361	57.4448	6667104	13.843	781.80	5021560	1.8224	86.141	786891

	POP4	GDP4	PRD4	POP5	GDP5	PRD5	POP6	GDP6	PRD6
MEAN	220.775	1026.28	74970262	117.796	59.5726	21399515	1053.97	455.847	3.3E+08
ST DEV	39.736	773.25	6809308	19.214	61.3033	12514304	148.83	392.511	43384738

	POP7	GDP7	PRD7	POP9	GDP9	PRD9	YEAR
MEAN	322.735	40.9010	78918562	147.078	326.541	23154014	1972.00
ST DEV	57.458	29.7545	13001984	5.799	139.045	1700091	6.20

CORRELATIONS

	POP1	GDP1	PRD1	POP2	GDP2	PRD2	POP3	GDP3	PRD3
POP1	1.0000	0.8866	0.7177	0.8963	0.9017	0.8826	0.8873	0.9137	0.8050
GDP1	0.8866	1.0000	0.6814	0.8552	0.9058	0.7962	0.8348	0.9000	0.8132
PRD1	0.7177	0.6814	1.0000	0.8867	0.7855	0.8271	0.8990	0.7756	0.6945
POP2	0.8963	0.8552	0.8867	1.0000	0.9580	0.9475	0.9981	0.9678	0.8340
GDP2	0.9017	0.9058	0.7855	0.9580	1.0000	0.9373	0.9422	0.9941	0.9270
PRD2	0.8826	0.7962	0.8271	0.9475	0.9373	1.0000	0.9454	0.9437	0.8963
POP3	0.8873	0.8348	0.8990	0.9981	0.9422	0.9454	1.0000	0.9552	0.8143
GDP3	0.9137	0.9000	0.7756	0.9678	0.9941	0.9437	0.9552	1.0000	0.9019
PRD3	0.8050	0.8132	0.6945	0.8340	0.9270	0.8963	0.8143	0.9019	1.0000
POP4	0.8460	0.7975	0.6644	0.9125	0.8802	0.8768	0.9079	0.9155	0.7487
GDP4	0.9376	0.8647	0.7007	0.9022	0.9017	0.8892	0.8872	0.9093	0.8183
PRD4	-0.6229	-0.4979	-0.6096	-0.7098	-0.5650	-0.5874	-0.7295	-0.6245	-0.3455
POP5	0.8985	0.8671	0.8614	0.9977	0.9703	0.9511	0.9934	0.9807	0.8506
GDP5	0.8740	0.8941	0.6962	0.9069	0.9822	0.8989	0.8882	0.9783	0.9217
PRD5	0.8548	0.8846	0.7371	0.8723	0.9580	0.8887	0.8471	0.9305	0.9572
POP6	0.8933	0.8535	0.8567	0.9969	0.9690	0.9531	0.9925	0.9795	0.8487
GDP6	0.9271	0.9227	0.7536	0.9476	0.9920	0.9223	0.9294	0.9871	0.9101
PRD6	0.9199	0.8438	0.7510	0.9421	0.9355	0.9281	0.9318	0.9477	0.8433
POP7	0.9158	0.8783	0.8484	0.9932	0.9831	0.9553	0.9864	0.9892	0.8763
GDP7	0.8979	0.9323	0.7364	0.9306	0.9829	0.8942	0.9095	0.9737	0.9096
PRD7	0.8989	0.8646	0.8560	0.9927	0.9718	0.9527	0.9889	0.9815	0.8672
POP9	0.8997	0.8536	0.8825	0.9996	0.9576	0.9508	0.9983	0.9685	0.8352
GDP9	0.9186	0.8971	0.8257	0.9219	0.9332	0.8935	0.9066	0.9196	0.8589
PRD9	0.7083	0.7335	0.5984	0.6802	0.7732	0.7330	0.6536	0.7310	0.8517
YEAR	0.8999	0.8539	0.8815	0.9997	0.9579	0.9507	0.9982	0.9690	0.8341

APPENDIX F--continued

CORRELATIONS

	POP4	GDP4	PRD4	POP5	GDP5	PRD5	POP6	GDP6	PRD6
POP1	0.8460	0.9376	-0.6229	0.8985	0.8740	0.8548	0.8933	0.9271	0.9199
GDP1	0.7975	0.8647	-0.4979	0.8671	0.8941	0.8846	0.8535	0.9227	0.8438
PRD1	0.6644	0.7007	-0.6096	0.8614	0.6962	0.7371	0.8567	0.7536	0.7510
POP2	0.9125	0.9022	-0.7098	0.9977	0.9069	0.8723	0.9969	0.9476	0.9421
GDP2	0.8802	0.9017	-0.5650	0.9703	0.9822	0.9580	0.9690	0.9920	0.9355
PRD2	0.8768	0.8892	-0.5874	0.9511	0.8989	0.8887	0.9531	0.9223	0.9281
POP3	0.9079	0.8872	-0.7295	0.9934	0.8882	0.8471	0.9925	0.9294	0.9318
GDP3	0.9155	0.9093	-0.6245	0.9807	0.9783	0.9305	0.9795	0.9871	0.9477
PRD3	0.7487	0.8183	-0.3455	0.8506	0.9217	0.9572	0.8487	0.9101	0.8433
POP4	1.0000	0.8886	-0.7027	0.9225	0.8528	0.7599	0.9261	0.8845	0.9349
GDP4	0.8886	1.0000	-0.5858	0.9074	0.8501	0.8690	0.9065	0.9328	0.9454
PRD4	-0.7027	-0.5858	1.0000	-0.7001	-0.5139	-0.3925	-0.6969	-0.5509	-0.6242
POP5	0.9225	0.9074	-0.7001	1.0000	0.9268	0.8872	0.9991	0.9596	0.9496
GDP5	0.8528	0.8501	-0.5139	0.9268	1.0000	0.9415	0.9253	0.9761	0.8971
PRD5	0.7599	0.8690	-0.3925	0.8872	0.9415	1.0000	0.8834	0.9533	0.8789
POP6	0.9261	0.9065	-0.6969	0.9991	0.9253	0.8834	1.0000	0.9582	0.9521
GDP6	0.8845	0.9328	-0.5509	0.9596	0.9761	0.9533	0.9582	1.0000	0.9488
PRD6	0.9349	0.9454	-0.6242	0.9496	0.8971	0.8789	0.9521	0.9488	1.0000
POP7	0.9141	0.9142	-0.6685	0.9976	0.9459	0.9100	0.9969	0.9744	0.9550
GDP7	0.8661	0.9279	-0.5238	0.9444	0.9640	0.9555	0.9406	0.9910	0.9213
PRD7	0.9142	0.9074	-0.6975	0.9965	0.9328	0.8926	0.9949	0.9599	0.9461
POP9	0.9173	0.9050	-0.7117	0.9978	0.9072	0.8702	0.9971	0.9476	0.9462
GDP9	0.7706	0.9307	-0.5502	0.9222	0.8764	0.9297	0.9162	0.9420	0.8898
PRD9	0.5745	0.7506	-0.0379	0.6883	0.7507	0.8694	0.6860	0.7865	0.7243
YEAR	0.9173	0.9054	-0.7118	0.9980	0.9074	0.8705	0.9974	0.9481	0.9468

	POP7	GDP7	PRD7	POP9	GDP9	PRD9	YEAR
POP1	0.9108	0.8979	0.8969	0.8997	0.9186	0.7083	0.8999
GDP1	0.8783	0.9323	0.8646	0.8536	0.8971	0.7335	0.8539
PRD1	0.8484	0.7364	0.8560	0.8825	0.8257	0.5984	0.8815
POP2	0.9932	0.9306	0.9927	0.9996	0.9219	0.6802	0.9997
GDP2	0.9831	0.9829	0.9718	0.9576	0.9332	0.7732	0.9579
PRD2	0.9553	0.8942	0.9527	0.9508	0.8935	0.7330	0.9507
POP3	0.9864	0.9095	0.9889	0.9983	0.9066	0.6536	0.9982
GDP3	0.9892	0.9737	0.9815	0.9685	0.9196	0.7310	0.9690
PRD3	0.8763	0.9096	0.8672	0.8352	0.8589	0.8517	0.8341
POP4	0.9141	0.8661	0.9142	0.9173	0.7706	0.5745	0.9173
GDP4	0.9142	0.9279	0.9074	0.9050	0.9307	0.7506	0.9054
PRD4	-0.6685	-0.5238	-0.6975	-0.7117	-0.5502	-0.0379	-0.7118
POP5	0.9976	0.9444	0.9965	0.9978	0.9222	0.6883	0.9980
GDP5	0.9459	0.9640	0.9328	0.9072	0.8764	0.7507	0.9074
PRD5	0.9100	0.9555	0.8926	0.8702	0.9297	0.8694	0.8705
POP6	0.9969	0.9406	0.9949	0.9971	0.9162	0.6860	0.9974
GDP6	0.9744	0.9910	0.9599	0.9476	0.9420	0.7865	0.9481
PRD6	0.9550	0.9213	0.9461	0.9462	0.8898	0.7243	0.9468
POP7	1.0000	0.9581	0.9963	0.9935	0.9329	0.7166	0.9937
GDP7	0.9581	1.0000	0.9465	0.9296	0.9391	0.7975	0.9298
PRD7	0.9963	0.9465	1.0000	0.9939	0.9227	0.6959	0.9936
POP9	0.9935	0.9296	0.9939	1.0000	0.9190	0.6782	0.9999
GDP9	0.9329	0.9391	0.9227	0.9190	1.0000	0.7874	0.9202
PRD9	0.7166	0.7975	0.6959	0.6782	0.7874	1.0000	0.6786
YEAR	0.9937	0.9298	0.9936	0.9999	0.9202	0.6786	1.0000

APPENDIX F--continued

	EIGENVALUE	DIFFERENCE	PROPORTION	CUMULATIVE
PRIN1	22.0490	20.6693	0.881959	0.88196
PRIN2	1.3797	0.8576	0.055187	0.93715
PRIN3	0.5221	0.2049	0.020882	0.95803
PRIN4	0.3171	0.0480	0.012685	0.97071
PRIN5	0.2692	0.1143	0.010766	0.98148
PRIN6	0.1549	0.0687	0.006195	0.98767
PRIN7	0.0862	0.0190	0.003447	0.99112
PRIN8	0.0671	0.0132	0.002685	0.99381
PRIN9	0.0539	0.0113	0.002157	0.99596
PRIN10	0.0426	0.0195	0.001705	0.99767
PRIN11	0.0231	0.0079	0.000923	0.99859
PRIN12	0.0152	0.0056	0.000606	0.99920
PRIN13	0.0095	0.0049	0.000381	0.99958
PRIN14	0.0047	0.0014	0.000186	0.99976
PRIN15	0.0033	0.0019	0.000132	0.99990
PRIN16	0.0014	0.0006	0.000055	0.99995
PRIN17	0.0008	0.0005	0.000030	0.99998
PRIN18	0.0003	0.0001	0.000011	0.99999
PRIN19	0.0002	0.0001	0.000006	1.00000
PRIN20	0.0000	0.0000	0.000001	1.00000
PRIN21	0.0000	0.0000	0.000000	1.00000
PRIN22	0.0000	0.0000	0.000000	1.00000
PRIN23	0.0000	0.0000	0.000000	1.00000
PRIN24	0.0000	0.0000	0.000000	1.00000
PRIN25	0.0000	.	0.000000	1.00000

EIGENVECTORS

	PRIN1	PRIN2	PRIN3	PRIN4	PRIN5	PRIN6	PRIN7	PRIN8	PRIN9
POP1	0.198360	0.003618	-.214899	-.412061	0.093198	-.291829	0.579357	0.285496	-.192900
GDP1	0.192292	0.124702	-.230874	-.335960	-.421842	0.410214	0.329590	-.438679	0.185157
PRD1	0.177460	-.149793	0.698565	-.167248	-.062962	0.113316	0.136656	-.128024	-.022569
POP2	0.209766	-.118116	0.116200	0.023373	0.020935	0.122997	-.021060	0.060262	0.005505
GDP2	0.210176	0.076043	-.039542	0.148086	-.167247	-.010659	-.050109	0.139652	0.004689
PRD2	0.204015	-.002504	0.129687	0.182752	0.260073	-.324233	0.323028	-.051593	0.492030
POP3	0.207679	-.153755	0.152233	0.028084	0.044639	0.116439	0.061524	0.050039	0.010784
GDP3	0.210782	0.010856	-.103494	0.162846	-.112706	-.004162	0.030320	0.131921	-.013193
PRD3	0.191141	0.281125	0.059534	0.301539	-.060356	-.441738	0.051677	-.499641	0.009692
POP4	0.193888	-.162729	-.326691	0.236955	0.361949	0.322993	0.069088	-.303723	0.047056
GDP4	0.199701	0.035034	-.224935	-.351650	0.356002	-.098663	-.348468	-.088830	0.268885
PRD4	-.135426	0.622204	0.142657	0.130797	0.180352	0.337195	0.154967	0.300743	0.408961
POP5	0.210894	-.096929	0.057323	0.075785	-.005340	0.105886	-.054611	0.053621	0.015621
GDP5	0.202488	0.121103	-.164674	0.293300	-.295591	-.043594	0.151914	0.260672	-.133068
PRD5	0.198652	0.261427	0.037803	0.026089	-.184716	-.220644	-.207981	-.120215	-.112882
POP6	0.210477	-.099361	0.056666	0.108901	0.034940	0.097506	-.087623	0.120901	0.022565
GDP6	0.209646	0.095535	-.130042	0.017133	-.098169	0.032561	-.074970	0.251591	0.008138
PRD6	0.204916	-.021511	-.149807	0.001417	0.348798	-.004260	-.014612	0.048414	-.193378
POP7	0.212048	-.051774	0.036407	0.081711	-.027880	0.040903	-.030014	0.130855	-.005888
GDP7	0.206891	0.126189	-.135620	-.007932	-.169410	0.126497	-.322118	0.027145	0.059829
PRD7	0.210857	-.084340	0.056141	0.091998	-.023518	0.013334	-.068372	-.016504	-.056349
POP9	0.209866	-.120438	0.103827	0.031081	0.043460	0.107018	0.008845	0.053669	0.014428
GDP9	0.202300	0.086950	0.106235	-.419913	-.118382	-.194965	-.281784	0.139281	0.277138
PRD9	0.161378	0.500516	0.189240	-.142958	0.320770	0.159169	-.022415	-.114277	-.539428
YEAR	0.209896	-.120227	0.101926	0.028403	0.043301	0.108860	0.000231	0.068752	0.015966

APPENDIX F--continued

EIGENVECTORS

	PRIN10	PRIN11	PRIN12	PRIN13	PRIN14	PRIN15	PRIN16	PRIN17	PRIN18
POP1	-.088339	0.235048	0.186851	0.161598	-.105280	0.180057	0.035523	0.044974	0.062876
GDP1	0.103536	-.144489	-.183743	-.086298	-.027534	-.024239	-.130110	0.005968	-.074425
PRD1	0.223863	0.221995	0.310342	-.131753	0.232944	0.010687	0.207622	-.228760	-.099320
POP2	-.060513	0.036221	0.013960	0.108661	-.098094	-.235953	-.051890	0.174941	0.043208
GDP2	0.026224	0.016678	0.058945	0.246809	-.031041	0.103346	-.368441	-.618231	-.067930
PRD2	-.089089	-.451374	0.026542	-.301422	-.225640	-.045041	0.046571	-.157886	0.027087
POP3	-.107872	0.086356	-.036601	-.011643	-.116217	-.083651	-.174219	0.343943	-.053896
GDP3	-.074826	-.122980	-.056775	0.212173	0.104736	0.238878	0.348498	-.004467	-.520223
PRD3	-.042728	0.484271	-.218491	0.160968	-.013597	-.127030	-.002546	0.079027	-.033615
POP4	-.052207	0.008254	0.317558	0.312677	0.217163	-.037228	0.251722	-.123565	0.291061
GDP4	-.103271	0.172561	0.181065	-.250371	0.322311	0.016516	-.254122	0.075235	-.346702
PRD4	0.128111	0.203342	0.006436	0.119583	0.074469	0.162105	-.014947	0.140421	0.032554
POP5	-.047745	-.085200	-.089310	0.104791	-.107478	0.094096	0.117023	0.154234	-.237685
GDP5	-.045580	-.056038	0.073680	-.366761	0.494909	-.275838	0.157445	0.189469	0.043639
PRD5	0.347498	-.362882	0.503199	0.155998	-.035272	0.210957	-.181225	0.308543	0.120743
POP6	-.031722	-.079010	-.060909	0.160527	-.033671	-.140106	-.133114	-.032375	-.080477
GDP6	0.087005	0.165199	0.080494	-.161615	-.072516	-.378552	-.173215	-.272396	0.181667
PRD6	0.761367	0.011521	-.353980	-.141720	-.080381	-.006853	0.129909	-.018825	-.024641
POP7	-.007014	0.015318	-.123411	0.076989	0.018693	0.088037	-.154415	-.025345	-.225713
GDP7	-.118875	0.253354	0.199178	-.302855	-.539389	0.150543	0.424940	-.051095	0.056196
PRD7	-.153080	0.037610	-.298528	-.261894	0.255797	0.645262	-.105547	-.058501	0.383270
POP9	-.049889	0.070986	-.032240	0.027582	-.107289	0.048000	-.214025	0.241885	0.281116
GDP9	-.033697	-.149002	-.291983	0.347247	0.197422	-.166772	0.335973	-.031997	0.314353
PRD9	-.336915	-.267328	-.096778	-.072868	-.040599	-.118688	0.016456	-.120023	-.027747
YEAR	-.045610	0.026101	-.053684	0.070676	-.108182	-.083422	-.087635	0.177651	0.010245

	PRIN19	PRIN20	PRIN21	PRIN22	PRIN23	PRIN24	PRIN25
POP1	0.065575	0.041678	0.013632	0.055875	0.017664	-.000465	0.109301
GDP1	0.043734	0.020777	-.010585	-.005053	-.016612	0.013306	0.011555
PRD1	0.053849	-.033112	-.030101	0.000690	0.002674	-.005793	-.006021
POP2	-.350004	0.034073	-.182906	-.003903	-.193350	0.418683	0.142084
GDP2	-.122766	0.182493	0.170168	-.024000	0.385473	-.001669	-.178956
PRD2	-.074786	0.015194	-.024510	-.009075	-.019334	-.014510	-.012930
POP3	-.202757	-.104478	0.572509	0.323725	-.129658	-.164537	-.407687
GDP3	0.055890	-.098474	-.044210	-.239044	-.305169	0.263767	-.351124
PRD3	0.145539	-.023092	-.016287	0.011679	0.001973	0.023962	0.038720
POP4	-.059755	-.064286	0.024644	0.050391	-.038307	-.112724	0.012801
GDP4	0.014447	0.043778	-.022073	-.038516	0.085909	0.064155	-.021073
PRD4	0.009437	0.026352	0.023523	0.017739	-.003343	0.022896	0.045037
POP5	-.165413	-.382153	-.135645	0.404138	0.459124	0.250366	0.385060
GDP5	0.002903	0.137645	0.023336	0.007525	0.263319	-.124537	-.002321
PRD5	-.005391	-.034496	0.036903	0.014783	-.108286	0.008644	0.062284
POP6	0.216751	0.201647	0.139508	0.202867	-.079832	0.009088	0.199180
GDP6	-.043192	-.495659	-.087091	0.044453	-.409966	0.261747	0.055870
PRD6	-.021907	0.095164	0.051450	-.004304	0.072738	-.006416	-.079956
POP7	-.191183	0.026083	-.383545	0.074149	-.306156	-.697934	0.219522
GDP7	0.059924	0.160019	0.043614	0.002385	0.064607	-.157508	-.017472
PRD7	-.007182	0.017221	0.112691	0.034866	-.186161	0.175315	0.149981
POP9	0.207371	-.114231	-.553958	-.138887	0.264505	0.011421	-.504431
GDP9	-.057926	-.015194	0.056739	0.037411	0.038275	-.113817	-.070371
PRD9	-.013213	-.019649	-.020043	-.013164	0.009593	-.019768	-.044262
YEAR	-.026611	-.177245	0.286270	-.771641	0.136307	-.081722	0.328903

APPENDIX G
COMPUTER PROGRAM FOR ESTIMATING THE WORLD TRADE SYSTEM FOR FRESH VEGETABLES

APPENDIX G

COMPUTER PROGRAM FOR ESTIMATING THE WORLD TRADE SYSTEM FOR FRESH VEGETABLES

```
//MILK JOB (1001,1291,1400,60,0),FITZ,CLASS=1
/*PASSWORD    1,JNDPBJ
/*ROUTE  PRINT N1R0
//  EXEC SAS,REGION=8000K,SORT=20
//WORK    DD
VOL=SER=WORK03,UNIT=3380,SPACE=(CYL,(50,15),RLSE)
//AMY     DD DSN=UF.D0011204.SASBASE,DISP=(OLD,KEEP)
//SYSIN DD *
*-------------------------------------------------------*
|   TRADE8 JOB A1                                        |
|   40011267 9                                           |
|                                                        |
|   USING PRINCIPAL COMPONENTS ANALYSIS                  |
|                                                        |
|                                                        |
|   PROGRAM EDITED FRIDAY NOV7                           |
|   CONTAINS ONLY JCL AND MODELLING PROCEDURES           |
|                                                        |
|   SYSNLIN PROCEDURE WITH INPUTS TYPED OUT              |
|                                                        |
|   EXTRA PARAMETERS REMOVED TO ACCOUNT FOR              |
|   ESTIMATING SOME D'S BY DEFAULT                       |
|                                                        |
|   3 CORRECTIONS TO TSPARKS, PLUS DELETING 1983 AND     |
|   1984 TO CREATE FINAL DATA SET, SYSNDAT               |
|                                                        |
|   ALL REFERENCES  TO REGION 8 REMOVED                    |
*-------------------------------------------------------*;
PROC PRINCOMP DATA=AMY.SYSNDAT OUT=AA; VAR
POP1 GDP1 PRD1 POP2 GDP2 PRD2 POP3 GDP3 PRD3
POP4 GDP4 PRD4 POP5 GDP5 PRD5 POP6 GDP6 PRD6
POP7 GDP7 PRD7 POP9 GDP9 PRD9 YEAR;
PROC SYSNLIN  DATA=AA N2SLS LIST  DW OUTEST=AMY.ESTIMATE
OUTPREDICT OUTACTUAL
OUT=AMY.PREDICT;
INSTRUMENTS PRIN1 PRIN2 PRIN3 PRIN4 PRIN5;
ENDOGENOUS
LIQ1D IQ1D LEXQD1  MP1D EXPORT1 IMPORT1 EPD1 MPP1D
LIQ2D IQ2D LEXQD2  MP2D EXPORT2 IMPORT2 EPD2 MPP2D
LIQ3D IQ3D LEXQD3  MP3D EXPORT3 IMPORT3 EPD3 MPP3D
LIQ4D IQ4D LEXQD4  MP4D EXPORT4 IMPORT4 EPD4 MPP4D
LIQ5D IQ5D LEXQD5  MP5D EXPORT5 IMPORT5 EPD5 MPP5D
```

```
LIQ6D IQ6D LEXQD6  MP6D EXPORT6 IMPORT6 EPD6 MPP6D
LIQ7D IQ7D LEXQD7  MP7D EXPORT7 IMPORT7 EPD7 MPP7D
LIQ9D IQ9D LEXQD9  MP9D EXPORT9 IMPORT9 EPD9 MPP9D
IQ11           MP11 IQ12 IP12 EP12 MP12 IQ13 IP13 EP13 MP13
IQ14 IP14 EP14 MP14 IQ15 IP15 EP15 MP15 IQ16 IP16 EP16 MP16
IQ17 IP17 EP17 MP17 IQ19 IP19 EP19 MP19
IQ21 IP21 EP21 MP21 IQ22           MP22 IQ23 IP23 EP23 MP23
IQ24 IP24 EP24 MP24 IQ25 IP25 EP25 MP25 IQ26 IP26 EP26 MP26
IQ27 IP27 EP27 MP27  IQ29 IP29 EP29 MP29
IQ31 IP31 EP31 MP31 IQ32 IP32 EP32 MP32 IQ33           MP33
IQ34 IP34 EP34 MP34 IQ35 IP35 EP35 MP35 IQ36 IP36 EP36 MP36
IQ37 IP37 EP37 MP37 IQ39 IP39 EP39 MP39
IQ41 IP41 EP41 MP41 IQ42 IP42 EP42 MP42 IQ43 IP43 EP43 MP43
IQ44           MP44 IQ45 IP45 EP45 MP45 IQ46 IP46 EP46 MP46
IQ47 IP47 EP47 MP47 IQ49 IP49 EP49 MP49
IQ51 IP51 EP51 MP51 IQ52 IP52 EP52 MP52 IQ53 IP53 EP53 MP53
IQ54 IP54 EP54 MP54 IQ55           MP55 IQ56 IP56 EP56 MP56
IQ57 IP57 EP57 MP57 IQ59 IP59 EP59 MP59
IQ61 IP61 EP61 MP61 IQ62 IP62 EP62 MP62 IQ63 IP63 EP63 MP63
IQ64 IP64 EP64 MP64 IQ65 IP65 EP65 MP65 IQ66           MP66
IQ67 IP67 EP67 MP67 IQ69 IP69 EP69 MP69
IQ71 IP71 EP71 MP71 IQ72 IP72 EP72 MP72 IQ73 IP73 EP73 MP73
IQ74 IP74 EP74 MP74 IQ75 IP75 EP75 MP75 IQ76 IP76 EP76 MP76
IQ77           MP77 IQ79 IP79 EP79 MP79
IQ91 IP91 EP91 MP91 IQ92 IP92 EP92 MP92 IQ93 IP93 EP93 MP93
IQ94 IP94 EP94 MP94 IQ95 IP95 EP95 MP95 IQ96 IP96 EP96 MP96
IQ97 IP97 EP97 MP97 IQ99           MP99
                  LIP12 LIQ13 LIP13
LIQ14 LIP14 LIQ15 LIP15 LIQ16 LIP16
LIQ17 LIP17 LIQ19 LIP19
LIQ21 LIP21                   LIP23
LIQ24 LIP24 LIQ25 LIP25 LIQ26 LIP26
LIQ27 LIP27 LIQ29 LIP29
LIQ31 LIP31 LIQ32 LIP32
      LIP34 LIQ35 LIP35 LIQ36 LIP36
LIQ37 LIP37 LIQ39 LIP39
LIQ41 LIP41 LIQ42 LIP42 LIQ43 LIP43
                  LIP45 LIQ46 LIP46
LIQ47 LIP47 LIQ49 LIP49
LIQ51 LIP51 LIQ52 LIP52 LIQ53 LIP53
LIQ54 LIP54                   LIP56
LIQ57 LIP57 LIQ59 LIP59
LIQ61 LIP61 LIQ62 LIP62 LIQ63 LIP63
LIQ64 LIP64 LIQ65 LIP65
      LIP67 LIQ69 LIP69
LIQ71 LIP71 LIQ72 LIP72 LIQ73 LIP73
LIQ74 LIP74 LIQ75 LIP75 LIQ76 LIP76
                        LIP79
      LIP91 LIQ92 LIP92 LIQ93 LIP93
LIQ94 LIP94 LIQ95 LIP95 LIQ96 LIP96
LIQ97 LIP97;
EXOGENOUS    PRIN1 PRIN2 PRIN3 PRIN4 PRIN5
POP1 GDP1          PRD1 ACPI2 YEAR
POP2 GDP2          PRD2
```

```
POP3 GDP3            PRD3
POP4 GDP4            PRD4
POP5 GDP5            PRD5
POP6 GDP6            PRD6
POP7 GDP7            PRD7
POP9 GDP9            PRD9
     TRF12 TRF13 TRF14 TRF15 TRF16 TRF17  TRF19
TRF21       TRF23 TRF24 TRF25 TRF26 TRF27  TRF29
TRF31 TRF32       TRF34 TRF35 TRF36 TRF37  TRF39
TRF41 TRF42 TRF43       TRF45 TRF46 TRF47 TRF49
TRF51 TRF52 TRF53 TRF54       TRF56 TRF57 TRF59
TRF61 TRF62 TRF63 TRF64 TRF65       TRF67 TRF69
TRF71 TRF72 TRF73 TRF74 TRF75 TRF76       TRF79
TRF91 TRF92 TRF93 TRF94 TRF95 TRF96 TRF97       ;
 /*  TRADE MODEL EQUATIONS AND IDENTITIES */;
MP12 = ( 1 + TRF12 )*IP12;
MP13 = ( 1 + TRF13 )*IP13;MP14 = ( 1 + TRF14 )*IP14;
MP15 = ( 1 + TRF15 )*IP15;MP16 = ( 1 + TRF16 )*IP16;
MP17 = ( 1 + TRF17 )*IP17;
MP19 = ( 1 + TRF19 )*IP19;
MP21 = ( 1 + TRF21 )*IP21;
MP23 = ( 1 + TRF23 )*IP23;MP24 = ( 1 + TRF24 )*IP24;
MP25 = ( 1 + TRF25 )*IP25;MP26 = ( 1 + TRF26 )*IP26;
MP27 = ( 1 + TRF27 )*IP27;
MP29 = ( 1 + TRF29 )*IP29;
MP31 = ( 1 + TRF31 )*IP31;MP32 = ( 1 + TRF32 )*IP32;
MP34 = ( 1 + TRF34 )*IP34;
MP35 = ( 1 + TRF35 )*IP35;MP36 = ( 1 + TRF36 )*IP36;
MP37 = ( 1 + TRF37 )*IP37;
MP39 = ( 1 + TRF39 )*IP39;
MP41 = ( 1 + TRF41 )*IP41;MP42 = ( 1 + TRF42 )*IP42;
MP43 = ( 1 + TRF43 )*IP43;
MP45 = ( 1 + TRF45 )*IP45;MP46 = ( 1 + TRF46 )*IP46;
MP47 = ( 1 + TRF47 )*IP47;
MP49 = ( 1 + TRF49 )*IP49;
MP51 = ( 1 + TRF51 )*IP51;MP52 = ( 1 + TRF52 )*IP52;
MP53 = ( 1 + TRF53 )*IP53;MP54 = ( 1 + TRF54 )*IP54;
MP56 = ( 1 + TRF56 )*IP56;
MP57 = ( 1 + TRF57 )*IP57;
MP59 = ( 1 + TRF59 )*IP59;
MP61 = ( 1 + TRF61 )*IP61;MP62 = ( 1 + TRF62 )*IP62;
MP63 = ( 1 + TRF63 )*IP63;MP64 = ( 1 + TRF64 )*IP64;
MP65 = ( 1 + TRF65 )*IP65;
MP67 = ( 1 + TRF67 )*IP67;
MP69 = ( 1 + TRF69 )*IP69;
MP71 = ( 1 + TRF71 )*IP71;MP72 = ( 1 + TRF72 )*IP72;
MP73 = ( 1 + TRF73 )*IP73;MP74 = ( 1 + TRF74 )*IP74;
MP75 = ( 1 + TRF75 )*IP75;MP76 = ( 1 + TRF76 )*IP76;
MP79 = ( 1 + TRF79 )*IP79;
MP91 = ( 1 + TRF91 )*IP91;MP92 = ( 1 + TRF92 )*IP92;
MP93 = ( 1 + TRF93 )*IP93;MP94 = ( 1 + TRF94 )*IP94;
MP95 = ( 1 + TRF95 )*IP95;MP96 = ( 1 + TRF96 )*IP96;
MP97 = ( 1 + TRF97 )*IP97;
EXPORT1 = SUM(IQ21,IQ31,IQ41,IQ51,IQ61,IQ71,IQ91);
```

```
 IMPORT1 = SUM(IQ12,IQ13,IQ14,IQ15,IQ16,IQ17,IQ19);
 IQ1D = PRD1 + IMPORT1 - EXPORT1;
 MPP1D = SUM(MP12*IQ12/IMPORT1,MP13*IQ13/IMPORT1,
        MP14*IQ14/IMPORT1,MP15*IQ15/IMPORT1,MP16*IQ16/IMPORT1,
      MP17*IQ17/IMPORT1,
        MP19*IQ19/IMPORT1);
 EPD1 = SUM(EP12*IQ21/EXPORT1,EP13*IQ31/EXPORT1,
        EP14*IQ41/EXPORT1,EP15*IQ51/EXPORT1,EP16*IQ61/EXPORT1,
        EP17*IQ71/EXPORT1,EP19*IQ91/EXPORT1);
 MP11 = EPD1;
 IQ11 = IQ1D - IMPORT1; LEXQD1 = LOG(EXPORT1); LIQ1D =
LOG(IQ1D);
 MP1D = ( MP11*IQ11 + MPP1D*IMPORT1) / IQ1D;
 LEXQD1 = DH01 + DH11*LOG(EPD1) + DH21*LOG(PRD1);
 LIQ1D = RH01 + RH11*LOG(MP1D/ACPI2) + RH21*LOG(GDP1/ACPI2)
+RH31*LOG(POP1);
 EXPORT2 = SUM(IQ12,IQ32,IQ42,IQ52,IQ62,IQ72,IQ92);
 IMPORT2 = SUM(IQ21,IQ23,IQ24,IQ25,IQ26,IQ27,IQ29);
 IQ2D = PRD2 + IMPORT2 - EXPORT2;
 MPP2D = SUM(MP21*IQ21/IMPORT2,MP23*IQ23/IMPORT2,
        MP24*IQ24/IMPORT2,MP25*IQ25/IMPORT2,MP26*IQ26/IMPORT2,
      MP27*IQ27/IMPORT2,
       MP29* IQ29/IMPORT2);
 EPD2 = SUM(EP21*IQ12/EXPORT2,EP23*IQ32/EXPORT2,
        EP24*IQ42/EXPORT2,EP25*IQ52/EXPORT2,EP26*IQ62/EXPORT2,
        EP27*IQ72/EXPORT2,EP29*IQ92/EXPORT2);
 MP22 = EPD2;
 IQ22 = IQ2D - IMPORT2; LEXQD2 = LOG(EXPORT2); LIQ2D =
LOG(IQ2D);
 MP2D = ( MP22*IQ22 + MPP2D*IMPORT2) / IQ2D;
 LEXQD2 = DH02 + DH12*LOG(EPD2) + DH22*LOG(PRD2);
 LIQ2D = RH02 + RH12*LOG(MP2D/ACPI2) + RH22*LOG(GDP2/ACPI2)
+RH32*LOG(POP2);
 EXPORT3 = SUM(IQ13,IQ23,IQ43,IQ53,IQ63,IQ73,IQ93);
 IMPORT3 = SUM(IQ31,IQ32,IQ34,IQ35,IQ36,IQ37,IQ39);
 IQ3D = PRD3 + IMPORT3 - EXPORT3;
 MPP3D = SUM(MP31*IQ31/IMPORT3,MP32*IQ32/IMPORT3,
        MP34*IQ34/IMPORT3,MP35*IQ35/IMPORT3,MP36*IQ36/IMPORT3,
     MP37*IQ37/IMPORT3,
       MP39*IQ39/IMPORT3);
 EPD3 = SUM(EP31*IQ13/EXPORT3,EP32*IQ23/EXPORT3,
        EP34*IQ43/EXPORT3,EP35*IQ53/EXPORT3,EP36*IQ63/EXPORT3,
        EP37*IQ73/EXPORT3,EP39*IQ93/EXPORT3);
 MP33 = EPD3;
 IQ33 = IQ3D - IMPORT3; LEXQD3 = LOG(EXPORT3); LIQ3D =
LOG(IQ3D);
 MP3D = ( MP33*IQ33 + MPP3D*IMPORT3) / IQ3D;
 LEXQD3 = DH03 + DH13*LOG(EPD3) + DH23*LOG(PRD3);
 LIQ3D = RH03 + RH13*LOG(MP3D/ACPI2) + RH23*LOG(GDP3/ACPI2)
+RH33*LOG(POP3);
 EXPORT4 = SUM(IQ14,IQ24,IQ34,IQ54,IQ64,IQ74,IQ94);
 IMPORT4 = SUM(IQ41,IQ42,IQ43,IQ45,IQ46,IQ47,IQ49);
 IQ4D = PRD4 + IMPORT4 - EXPORT4;
```

```
 MPP4D =
SUM(MP41*IQ41/IMPORT4,MP42*IQ42/IMPORT4,MP43*IQ43/IMPORT4,
        MP45*IQ45/IMPORT4,MP46*IQ46/IMPORT4,MP47*IQ47/IMPORT4,
                          MP49*IQ49/IMPORT4);
 EPD4 =
SUM(EP41*IQ14/EXPORT4,EP42*IQ24/EXPORT4,EP43*IQ34/EXPORT4,
        EP45*IQ54/EXPORT4,EP46*IQ64/EXPORT4,
        EP47*IQ74/EXPORT4,
EP49*IQ94/EXPORT4);
 MP44 = EPD4;
 IQ44 = IQ4D - IMPORT4; LEXQD4 = LOG(EXPORT4); LIQ4D =
LOG(IQ4D);
 MP4D = ( MP44*IQ44 + MPP4D*IMPORT4) / IQ4D;
 LEXQD4 = DH04 + DH14*LOG(EPD4) + DH24*LOG(PRD4);
 LIQ4D = RH04 + RH14*LOG(MP4D/ACPI2) + RH24*LOG(GDP4/ACPI2)
+RH34*LOG(POP4);
 EXPORT5 = SUM(IQ15,IQ25,IQ35,IQ45,IQ65,IQ75,     IQ95);
 IMPORT5 = SUM(IQ51,IQ52,IQ53,IQ54,IQ56,IQ57,     IQ59);
 IQ5D = PRD5 + IMPORT5 - EXPORT5;
 MPP5D =
SUM(MP51*IQ51/IMPORT5,MP52*IQ52/IMPORT5,MP53*IQ53/IMPORT5,
        MP54*IQ54/IMPORT5,MP56*IQ56/IMPORT5,MP57*IQ57/IMPORT5,
                          MP59*IQ59/IMPORT5);
 EPD5 =
SUM(EP51*IQ15/EXPORT5,EP52*IQ25/EXPORT5,EP53*IQ35/EXPORT5,
        EP54*IQ45/EXPORT5,EP56*IQ65/EXPORT5,
        EP57*IQ75/EXPORT5,
EP59*IQ95/EXPORT5);
 MP55 = EPD5;
 IQ55 = IQ5D - IMPORT5; LEXQD5 = LOG(EXPORT5); LIQ5D =
LOG(IQ5D);
 MP5D = ( MP55*IQ55 + MPP5D*IMPORT5) / IQ5D;
 LEXQD5 = DH05 + DH15*LOG(EPD5) + DH25*LOG(PRD5);
 LIQ5D = RH05 + RH15*LOG(MP5D/ACPI2) + RH25*LOG(GDP5/ACPI2)
+RH35*LOG(POP5);
 EXPORT6 = SUM(IQ16,IQ26,IQ36,IQ46,IQ56,IQ76,     IQ96);
 IMPORT6 = SUM(IQ61,IQ62,IQ63,IQ64,IQ65,IQ67,IQ69);
 IQ6D = PRD6 + IMPORT6 - EXPORT6;
 MPP6D =
SUM(MP61*IQ61/IMPORT6,MP62*IQ62/IMPORT6,MP63*IQ63/IMPORT6,
        MP64*IQ64/IMPORT6,MP65*IQ65/IMPORT6,MP67*IQ67/IMPORT6,
                          MP69*IQ69/IMPORT6);
 EPD6 =
SUM(EP61*IQ16/EXPORT6,EP62*IQ26/EXPORT6,EP63*IQ36/EXPORT6,
        EP64*IQ46/EXPORT6,EP65*IQ56/EXPORT6,
        EP67*IQ76/EXPORT6,
EP69*IQ96/EXPORT6);
 MP66 = EPD6;
 IQ66 = IQ6D - IMPORT6; LEXQD6 = LOG(EXPORT6); LIQ6D =
LOG(IQ6D);
 MP6D = ( MP66*IQ66 + MPP6D*IMPORT6) / IQ6D;
 LEXQD6 = DH06 + DH16*LOG(EPD6) + DH26*LOG(PRD6);
```

```
 LIQ6D = RH06 + RH16*LOG(MP6D/ACPI2) + RH26*LOG(GDP6/ACPI2)
+RH36*LOG(POP6);
 EXPORT7 = SUM(IQ17,IQ27,IQ37,IQ47,IQ57,IQ67,IQ97);
 IMPORT7 = SUM(IQ71,IQ72,IQ73,IQ74,IQ75,IQ76,IQ79);
 IQ7D = PRD7 + IMPORT7 - EXPORT7;
 MPP7D =
SUM(MP71*IQ71/IMPORT7,MP72*IQ72/IMPORT7,MP73*IQ73/IMPORT7,
        MP74*IQ74/IMPORT7,MP75*IQ75/IMPORT7,MP76*IQ76/IMPORT7,
                          MP79*IQ79/IMPORT7);
 EPD7 =
SUM(EP71*IQ17/EXPORT7,EP72*IQ27/EXPORT7,EP73*IQ37/EXPORT7,
        EP74*IQ47/EXPORT7,EP75*IQ57/EXPORT7,EP76*IQ67/EXPORT7,
                          EP79*IQ97/EXPORT7);
 MP77 = EPD7;
 IQ77 = IQ7D - IMPORT7; LEXQD7 = LOG(EXPORT7); LIQ7D =
LOG(IQ7D);
 MP7D = ( MP77*IQ77 + MPP7D*IMPORT7) / IQ7D;
 LEXQD7 = DH07 + DH17*LOG(EPD7) + DH27*LOG(PRD7);
 LIQ7D = RH07 + RH17*LOG(MP7D/ACPI2) + RH27*LOG(GDP7/ACPI2)
+RH37*LOG(POP7);
 EXPORT9 = SUM(IQ19,IQ29,IQ39,IQ49,IQ59,IQ69,IQ79);
 IMPORT9 = SUM(IQ91,IQ92,IQ93,IQ94,IQ95,IQ96,IQ97);
 IQ9D = PRD9 + IMPORT9 - EXPORT9;
 MPP9D =
SUM(MP91*IQ91/IMPORT9,MP92*IQ92/IMPORT9,MP93*IQ93/IMPORT9,
        MP94*IQ94/IMPORT9,MP95*IQ95/IMPORT9,MP96*IQ96/IMPORT9,
     MP97*IQ97/IMPORT9);
 EPD9 =
SUM(EP91*IQ19/EXPORT9,EP92*IQ29/EXPORT9,EP93*IQ39/EXPORT9,
        EP94*IQ49/EXPORT9,EP95*IQ59/EXPORT9,EP96*IQ69/EXPORT9,
        EP97*IQ79/EXPORT9);
 MP99 = EPD9;
 IQ99 = IQ9D - IMPORT9; LEXQD9 = LOG(EXPORT9); LIQ9D =
LOG(IQ9D);
 MP9D = ( MP99*IQ99 + MPP9D*IMPORT9) / IQ9D;
 LEXQD9 = DH09 + DH19*LOG(EPD9) + DH29*LOG(PRD9);
 LIQ9D = RH09 + RH19*LOG(MP9D/ACPI2) + RH29*LOG(GDP9/ACPI2)
+RH39*LOG(POP9);
 LIP12 = LOG(IP12);
 LIP12 = LH012 + LH112*LOG(EP21) + LH212*LOG(YEAR);
 LIQ13 = LOG(IQ13); LIP13 = LOG(IP13);
 LIQ13 = TH013 + TH113*LOG(MP13/MP1D) + TH213*LOG(IQ1D);
 LIP13 = LH013 + LH113*LOG(EP31) + LH213*LOG(YEAR);
 LIQ14 = LOG(IQ14); LIP14 = LOG(IP14);
 LIQ14 = TH014 + TH114*LOG(MP14/MP1D) + TH214*LOG(IQ1D);
 LIP14 = LH014 + LH114*LOG(EP41) + LH214*LOG(YEAR);
 LIQ15 = LOG(IQ15); LIP15 = LOG(IP15);
 LIQ15 = TH015 + TH115*LOG(MP15/MP1D) + TH215*LOG(IQ1D);
 LIP15 = LH015 + LH115*LOG(EP51) + LH215*LOG(YEAR);
 LIQ16 = LOG(IQ16); LIP16 = LOG(IP16);
 LIQ16 = TH016 + TH116*LOG(MP16/MP1D) + TH216*LOG(IQ1D);
 LIP16 = LH016 + LH116*LOG(EP61) + LH216*LOG(YEAR);
 LIQ17 = LOG(IQ17); LIP17 = LOG(IP17);
 LIQ17 = TH017 + TH117*LOG(MP17/MP1D) + TH217*LOG(IQ1D);
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LIP17 = LH017 + LH117*LOG(EP71) + LH217*LOG(YEAR);
LIQ19 = LOG(IQ19); LIP19 = LOG(IP19);
LIQ19 = TH019 + TH119*LOG(MP19/MP1D) + TH219*LOG(IQ1D);
LIP19 = LH019 + LH119*LOG(EP91) + LH219*LOG(YEAR);
LIQ21 = LOG(IQ21); LIP21 = LOG(IP21);
LIQ21 = TH021 + TH121*LOG(MP21/MP2D) + TH221*LOG(IQ2D);
LIP21 = LH021 + LH121*LOG(EP12) + LH221*LOG(YEAR);
LIP23 = LOG(IP23);
LIP23 = LH023 + LH123*LOG(EP32) + LH223*LOG(YEAR);
LIQ24 = LOG(IQ24); LIP24 = LOG(IP24);
LIQ24 = TH024 + TH124*LOG(MP24/MP2D) + TH224*LOG(IQ2D);
LIP24 = LH024 + LH124*LOG(EP42) + LH224*LOG(YEAR);
LIQ25 = LOG(IQ25); LIP25 = LOG(IP25);
LIQ25 = TH025 + TH125*LOG(MP25/MP2D) + TH225*LOG(IQ2D);
LIP25 = LH025 + LH125*LOG(EP52) + LH225*LOG(YEAR);
LIQ26 = LOG(IQ26); LIP26 = LOG(IP26);
LIQ26 = TH026 + TH126*LOG(MP26/MP2D) + TH226*LOG(IQ2D);
LIP26 = LH026 + LH126*LOG(EP62) + LH226*LOG(YEAR);
LIQ27 = LOG(IQ27); LIP27 = LOG(IP27);
LIQ27 = TH027 + TH127*LOG(MP27/MP2D) + TH227*LOG(IQ2D);
LIP27 = LH027 + LH127*LOG(EP72) + LH227*LOG(YEAR);
LIQ29 = LOG(IQ29); LIP29 = LOG(IP29);
LIQ29 = TH029 + TH129*LOG(MP29/MP2D) + TH229*LOG(IQ2D);
LIP29 = LH029 + LH129*LOG(EP92) + LH229*LOG(YEAR);
LIQ31 = LOG(IQ31); LIP31 = LOG(IP31);
LIQ31 = TH031 + TH131*LOG(MP31/MP3D) + TH231*LOG(IQ3D);
LIP31 = LH031 + LH131*LOG(EP13) + LH231*LOG(YEAR);
LIQ32 = LOG(IQ32); LIP32 = LOG(IP32);
LIQ32 = TH032 + TH132*LOG(MP32/MP3D) + TH232*LOG(IQ3D);
LIP32 = LH032 + LH132*LOG(EP23) + LH232*LOG(YEAR);
LIP34 = LOG(IP34);
LIP34 = LH034 + LH134*LOG(EP43) + LH234*LOG(YEAR);
LIQ35 = LOG(IQ35); LIP35 = LOG(IP35);
LIQ35 = TH035 + TH135*LOG(MP35/MP3D) + TH235*LOG(IQ3D);
LIP35 = LH035 + LH135*LOG(EP53) + LH235*LOG(YEAR);
LIQ36 = LOG(IQ36); LIP36 = LOG(IP36);
LIQ36 = TH036 + TH136*LOG(MP36/MP3D) + TH236*LOG(IQ3D);
LIP36 = LH036 + LH136*LOG(EP63) + LH236*LOG(YEAR);
LIQ37 = LOG(IQ37); LIP37 = LOG(IP37);
LIQ37 = TH037 + TH137*LOG(MP37/MP3D) + TH237*LOG(IQ3D);
LIP37 = LH037 + LH137*LOG(EP73) + LH237*LOG(YEAR);
LIQ39 = LOG(IQ39); LIP39 = LOG(IP39);
LIQ39 = TH039 + TH139*LOG(MP39/MP3D) + TH239*LOG(IQ3D);
LIP39 = LH039 + LH139*LOG(EP93) + LH239*LOG(YEAR);
LIQ41 = LOG(IQ41); LIP41 = LOG(IP41);
LIQ41 = TH041 + TH141*LOG(MP41/MP4D) + TH241*LOG(IQ4D);
LIP41 = LH041 + LH141*LOG(EP14) + LH241*LOG(YEAR);
LIQ42 = LOG(IQ42); LIP42 = LOG(IP42);
LIQ42 = TH042 + TH142*LOG(MP42/MP4D) + TH242*LOG(IQ4D);
LIP42 = LH042 + LH142*LOG(EP24) + LH242*LOG(YEAR);
LIQ43 = LOG(IQ43); LIP43 = LOG(IP43);
LIQ43 = TH043 + TH143*LOG(MP43/MP4D) + TH243*LOG(IQ4D);
LIP43 = LH043 + LH143*LOG(EP34) + LH243*LOG(YEAR);
LIP45 = LOG(IP45);
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LIP45 = LH045 + LH145*LOG(EP54) + LH245*LOG(YEAR);
LIQ46 = LOG(IQ46); LIP46 = LOG(IP46);
LIQ46 = TH046 + TH146*LOG(MP46/MP4D) + TH246*LOG(IQ4D);
LIP46 = LH046 + LH146*LOG(EP64) + LH246*LOG(YEAR);
LIQ47 = LOG(IQ47); LIP47 = LOG(IP47);
LIQ47 = TH047 + TH147*LOG(MP47/MP4D) + TH247*LOG(IQ4D);
LIP47 = LH047 + LH147*LOG(EP74) + LH247*LOG(YEAR);
LIQ49 = LOG(IQ49); LIP49 = LOG(IP49);
LIQ49 = TH049 + TH149*LOG(MP49/MP4D) + TH249*LOG(IQ4D);
LIP49 = LH049 + LH149*LOG(EP94) + LH249*LOG(YEAR);
LIQ51 = LOG(IQ51); LIP51 = LOG(IP51);
LIQ51 = TH051 + TH151*LOG(MP51/MP5D) + TH251*LOG(IQ5D);
LIP51 = LH051 + LH151*LOG(EP15) + LH251*LOG(YEAR);
LIQ52 = LOG(IQ52); LIP52 = LOG(IP52);
LIQ52 = TH052 + TH152*LOG(MP52/MP5D) + TH252*LOG(IQ5D);
LIP52 = LH052 + LH152*LOG(EP25) + LH252*LOG(YEAR);
LIQ53 = LOG(IQ53); LIP53 = LOG(IP53);
LIQ53 = TH053 + TH153*LOG(MP53/MP5D) + TH253*LOG(IQ5D);
LIP53 = LH053 + LH153*LOG(EP35) + LH253*LOG(YEAR);
LIQ54 = LOG(IQ54); LIP54 = LOG(IP54);
LIQ54 = TH054 + TH154*LOG(MP54/MP5D) + TH254*LOG(IQ5D);
LIP54 = LH054 + LH154*LOG(EP45) + LH254*LOG(YEAR);
LIP56 = LOG(IP56);
LIP56 = LH056 + LH156*LOG(EP65) + LH256*LOG(YEAR);
LIQ57 = LOG(IQ57); LIP57 = LOG(IP57);
LIQ57 = TH057 + TH157*LOG(MP57/MP5D) + TH257*LOG(IQ5D);
LIP57 = LH057 + LH157*LOG(EP75) + LH257*LOG(YEAR);
LIQ59 = LOG(IQ59); LIP59 = LOG(IP59);
LIQ59 = TH059 + TH159*LOG(MP59/MP5D) + TH259*LOG(IQ5D);
LIP59 = LH059 + LH159*LOG(EP95) + LH259*LOG(YEAR);
LIQ61 = LOG(IQ61); LIP61 = LOG(IP61);
LIQ61 = TH061 + TH161*LOG(MP61/MP6D) + TH261*LOG(IQ6D);
LIP61 = LH061 + LH161*LOG(EP16) + LH261*LOG(YEAR);
LIQ62 = LOG(IQ62); LIP62 = LOG(IP62);
LIQ62 = TH062 + TH162*LOG(MP62/MP6D) + TH262*LOG(IQ6D);
LIP62 = LH062 + LH162*LOG(EP26) + LH262*LOG(YEAR);
LIQ63 = LOG(IQ63); LIP63 = LOG(IP63);
LIQ63 = TH063 + TH163*LOG(MP63/MP6D) + TH263*LOG(IQ6D);
LIP63 = LH063 + LH163*LOG(EP36) + LH263*LOG(YEAR);
LIQ64 = LOG(IQ64); LIP64 = LOG(IP64);
LIQ64 = TH064 + TH164*LOG(MP64/MP6D) + TH264*LOG(IQ6D);
LIP64 = LH064 + LH164*LOG(EP46) + LH264*LOG(YEAR);
LIQ65 = LOG(IQ65); LIP65 = LOG(IP65);
LIQ65 = TH065 + TH165*LOG(MP65/MP6D) + TH265*LOG(IQ6D);
LIP65 = LH065 + LH165*LOG(EP56) + LH265*LOG(YEAR);
LIP67 = LOG(IP67);
LIP67 = LH067 + LH167*LOG(EP76) + LH267*LOG(YEAR);
LIQ69 = LOG(IQ69); LIP69 = LOG(IP69);
LIQ69 = TH069 + TH169*LOG(MP69/MP6D) + TH269*LOG(IQ6D);
LIP69 = LH069 + LH169*LOG(EP96) + LH269*LOG(YEAR);
LIQ71 = LOG(IQ71); LIP71 = LOG(IP71);
LIQ71 = TH071 + TH171*LOG(MP71/MP7D) + TH271*LOG(IQ7D);
LIP71 = LH071 + LH171*LOG(EP17) + LH271*LOG(YEAR);
LIQ72 = LOG(IQ72); LIP72 = LOG(IP72);
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LIQ72 = TH072 + TH172*LOG(MP72/MP7D) + TH272*LOG(IQ7D);
LIP72 = LH072 + LH172*LOG(EP27) + LH272*LOG(YEAR);
LIQ73 = LOG(IQ73); LIP73 = LOG(IP73);
LIQ73 = TH073 + TH173*LOG(MP73/MP7D) + TH273*LOG(IQ7D);
LIP73 = LH073 + LH173*LOG(EP37) + LH273*LOG(YEAR);
LIQ74 = LOG(IQ74); LIP74 = LOG(IP74);
LIQ74 = TH074 + TH174*LOG(MP74/MP7D) + TH274*LOG(IQ7D);
LIP74 = LH074 + LH174*LOG(EP47) + LH274*LOG(YEAR);
LIQ75 = LOG(IQ75); LIP75 = LOG(IP75);
LIQ75 = TH075 + TH175*LOG(MP75/MP7D) + TH275*LOG(IQ7D);
LIP75 = LH075 + LH175*LOG(EP57) + LH275*LOG(YEAR);
LIQ76 = LOG(IQ76); LIP76 = LOG(IP76);
LIQ76 = TH076 + TH176*LOG(MP76/MP7D) + TH276*LOG(IQ7D);
LIP76 = LH076 + LH176*LOG(EP67) + LH276*LOG(YEAR);
                    LIP79 = LOG(IP79);
LIP79 = LH079 + LH179*LOG(EP97) + LH279*LOG(YEAR);
LIP91 = LOG(IP91);
LIP91 = LH091 + LH191*LOG(EP19) + LH291*LOG(YEAR);
LIQ92 = LOG(IQ92); LIP92 = LOG(IP92);
LIQ92 = TH092 + TH192*LOG(MP92/MP9D) + TH292*LOG(IQ9D);
LIP92 = LH092 + LH192*LOG(EP29) + LH292*LOG(YEAR);
LIQ93 = LOG(IQ93); LIP93 = LOG(IP93);
LIQ93 = TH093 + TH193*LOG(MP93/MP9D) + TH293*LOG(IQ9D);
LIP93 = LH093 + LH193*LOG(EP39) + LH293*LOG(YEAR);
LIQ94 = LOG(IQ94); LIP94 = LOG(IP94);
LIQ94 = TH094 + TH194*LOG(MP94/MP9D) + TH294*LOG(IQ9D);
LIP94 = LH094 + LH194*LOG(EP49) + LH294*LOG(YEAR);
LIQ95 = LOG(IQ95); LIP95 = LOG(IP95);
LIQ95 = TH095 + TH195*LOG(MP95/MP9D) + TH295*LOG(IQ9D);
LIP95 = LH095 + LH195*LOG(EP59) + LH295*LOG(YEAR);
LIQ96 = LOG(IQ96); LIP96 = LOG(IP96);
LIQ96 = TH096 + TH196*LOG(MP96/MP9D) + TH296*LOG(IQ9D);
LIP96 = LH096 + LH196*LOG(EP69) + LH296*LOG(YEAR);
LIQ97 = LOG(IQ97); LIP97 = LOG(IP97);
LIQ97 = TH097 + TH197*LOG(MP97/MP9D) + TH297*LOG(IQ9D);
LIP97 = LH097 + LH197*LOG(EP79) + LH297*LOG(YEAR);
FIT
LEXQD1 KEEP=(DH01 DH11 DH21)
LIQ1D KEEP=(RH01 RH11 RH21 RH31)
LIP12 KEEP=(LH012 LH112 LH212)
LIP13 KEEP=(LH013 LH113 LH213)
LIQ13 KEEP=(TH013 TH113 TH213)
LIP14 KEEP=(LH014 LH114 LH214)
LIQ14 KEEP=(TH014 TH114 TH214)
LIP15 KEEP=(LH015 LH115 LH215)
LIQ15 KEEP=(TH015 TH115 TH215)
LIP16 KEEP=(LH016 LH116 LH216)
LIQ16 KEEP=(TH016 TH116 TH216)
LIP17 KEEP=(LH017 LH117 LH217)
LIQ17 KEEP=(TH017 TH117 TH217)
LIP19 KEEP=(LH019 LH119 LH219)
LIQ19 KEEP=(TH019 TH119 TH219)
LEXQD2 KEEP=(DH02 DH12 DH22)
LIQ2D KEEP=(RH02 RH12 RH22 RH32)
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LIP21 KEEP=(LH021 LH121 LH221)
LIQ21 KEEP=(TH021 TH121 TH221)
LIP23 KEEP=(LH023 LH123 LH223)
LIP24 KEEP=(LH024 LH124 LH224)
LIQ24 KEEP=(TH024 TH124 TH224)
LIP25 KEEP=(LH025 LH125 LH225)
LIQ25 KEEP=(TH025 TH125 TH225)
LIP26 KEEP=(LH026 LH126 LH226)
LIQ26 KEEP=(TH026 TH126 TH226)
LIP27 KEEP=(LH027 LH127 LH227)
LIQ27 KEEP=(TH027 TH127 TH227)
LIP29 KEEP=(LH029 LH129 LH229)
LIQ29 KEEP=(TH029 TH129 TH229)
LEXQD3 KEEP=(DH03 DH13 DH23)
LIQ3D KEEP=(RH03 RH13 RH23 RH33)
LIP31 KEEP=(LH031 LH131 LH231)
LIQ31 KEEP=(TH031 TH131 TH231)
LIP32 KEEP=(LH032 LH132 LH232)
LIQ32 KEEP=(TH032 TH132 TH232)
LIP34 KEEP=(LH034 LH134 LH234)
LIP35 KEEP=(LH035 LH135 LH235)
LIQ35 KEEP=(TH035 TH135 TH235)
LIP36 KEEP=(LH036 LH136 LH236)
LIQ36 KEEP=(TH036 TH136 TH236)
LIP37 KEEP=(LH037 LH137 LH237)
LIQ37 KEEP=(TH037 TH137 TH237)
LIP39 KEEP=(LH039 LH139 LH239)
LIQ39 KEEP=(TH039 TH139 TH239)
LEXQD4 KEEP=(DH04 DH14 DH24)
LIQ4D KEEP=(RH04 RH14 RH24 RH34)
LIP41 KEEP=(LH041 LH141 LH241)
LIQ41 KEEP=(TH041 TH141 TH241)
LIP42 KEEP=(LH042 LH142 LH242)
LIQ42 KEEP=(TH042 TH142 TH242)
LIP43 KEEP=(LH043 LH143 LH243)
LIQ43 KEEP=(TH043 TH143 TH243)
LIP45 KEEP=(LH045 LH145 LH245)
LIP46 KEEP=(LH046 LH146 LH246)
LIQ46 KEEP=(TH046 TH146 TH246)
LIP47 KEEP=(LH047 LH147 LH247)
LIQ47 KEEP=(TH047 TH147 TH247)
LIP49 KEEP=(LH049 LH149 LH249)
LIQ49 KEEP=(TH049 TH149 TH249)
LEXQD5 KEEP=(DH05 DH15 DH25)
LIQ5D KEEP=(RH05 RH15 RH25 RH35)
LIP51 KEEP=(LH051 LH151 LH251)
LIQ51 KEEP=(TH051 TH151 TH251)
LIP52 KEEP=(LH052 LH152 LH252)
LIQ52 KEEP=(TH052 TH152 TH252)
LIP53 KEEP=(LH053 LH153 LH253)
LIQ53 KEEP=(TH053 TH153 TH253)
LIP54 KEEP=(LH054 LH154 LH254)
LIQ54 KEEP=(TH054 TH154 TH254)
LIP56 KEEP=(LH056 LH156 LH256)
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LIP57 KEEP=(LH057 LH157 LH257)
LIQ57 KEEP=(TH057 TH157 TH257)
LIP59 KEEP=(LH059 LH159 LH259)
LIQ59 KEEP=(TH059 TH159 TH259)
LEXQD6 KEEP=(DH06 DH16 DH26)
LIQ6D KEEP=(RH06 RH16 RH26 RH36)
LIP61 KEEP=(LH061 LH161 LH261)
LIQ61 KEEP=(TH061 TH161 TH261)
LIP62 KEEP=(LH062 LH162 LH262)
LIQ62 KEEP=(TH062 TH162 TH262)
LIP63 KEEP=(LH063 LH163 LH263)
LIQ63 KEEP=(TH063 TH163 TH263)
LIP64 KEEP=(LH064 LH164 LH264)
LIQ64 KEEP=(TH064 TH164 TH264)
LIP65 KEEP=(LH065 LH165 LH265)
LIQ65 KEEP=(TH065 TH165 TH265)
LIP67 KEEP=(LH067 LH167 LH267)
LIP69 KEEP=(LH069 LH169 LH269)
LIQ69 KEEP=(TH069 TH169 TH269)
LEXQD7 KEEP=(DH07 DH17 DH27)
LIQ7D KEEP=(RH07 RH17 RH27 RH37)
LIP71 KEEP=(LH071 LH171 LH271)
LIQ71 KEEP=(TH071 TH171 TH271)
LIP72 KEEP=(LH072 LH172 LH272)
LIQ72 KEEP=(TH072 TH172 TH272)
LIP73 KEEP=(LH073 LH173 LH273)
LIQ73 KEEP=(TH073 TH173 TH273)
LIP74 KEEP=(LH074 LH174 LH274)
LIQ74 KEEP=(TH074 TH174 TH274)
LIP75 KEEP=(LH075 LH175 LH275)
LIQ75 KEEP=(TH075 TH175 TH275)
LIP76 KEEP=(LH076 LH176 LH276)
LIQ76 KEEP=(TH076 TH176 TH276)
LIP79 KEEP=(LH079 LH179 LH279)
LEXQD9 KEEP=(DH09 DH19 DH29)
LIQ9D KEEP=(RH09 RH19 RH29 RH39)
LIP91 KEEP=(LH091 LH191 LH291)
LIP92 KEEP=(LH092 LH192 LH292)
LIQ92 KEEP=(TH092 TH192 TH292)
LIP93 KEEP=(LH093 LH193 LH293)
LIQ93 KEEP=(TH093 TH193 TH293)
LIP94 KEEP=(LH094 LH194 LH294)
LIQ94 KEEP=(TH094 TH194 TH294)
LIP95 KEEP=(LH095 LH195 LH295)
LIQ95 KEEP=(TH095 TH195 TH295)
LIP96 KEEP=(LH096 LH196 LH296)
LIQ96 KEEP=(TH096 TH196 TH296)
LIP97 KEEP=(LH097 LH197 LH297)
LIQ97 KEEP=(TH097 TH197 TH297)
START=(
RH01 1 RH11 -1 RH21 1 RH31 1 DH01 1 DH11 1 DH21 1
RH02 1 RH12 -1 RH22 1 RH32 1 DH02 1 DH12 1 DH22 1
RH03 1 RH13 -1 RH23 1 RH33 1 DH03 1 DH13 1 DH23 1
RH04 1 RH14 -1 RH24 1 RH34 1 DH04 1 DH14 1 DH24 1
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RH05 1 RH15 -1 RH25 1 RH35 1 DH05 1 DH15 1 DH25 1
RH06 1 RH16 -1 RH26 1 RH36 1 DH06 1 DH16 1 DH26 1
RH07 1 RH17 -1 RH27 1 RH37 1 DH07 1 DH17 1 DH27 1
RH09 1 RH19 -1 RH29 1 RH39 1 DH09 1 DH19 1 DH29 1
TH013 1 TH113 -1 TH213 1 LH013 1 LH113 1 LH213 1
TH014 1 TH114 -1 TH214 1 LH014 1 LH114 1 LH214 1
TH015 1 TH115 -1 TH215 1 LH015 1 LH115 1 LH215 1
TH016 1 TH116 -1 TH216 1 LH016 1 LH116 1 LH216 1
TH017 1 TH117 -1 TH217 1 LH017 1 LH117 1 LH217 1
TH019 1 TH119 -1 TH219 1 LH019 1 LH119 1 LH219 1
TH021 1 TH121 -1 TH221 1 LH021 1 LH121 1 LH221 1
TH024 1 TH124 -1 TH224 1 LH024 1 LH124 1 LH224 1
TH025 1 TH125 -1 TH225 1 LH025 1 LH125 1 LH225 1
TH026 1 TH126 -1 TH226 1 LH026 1 LH126 1 LH226 1
TH027 1 TH127 -1 TH227 1 LH027 1 LH127 1 LH227 1
TH029 1 TH129 -1 TH229 1 LH029 1 LH129 1 LH229 1
TH031 1 TH131 -1 TH231 1 LH031 1 LH131 1 LH231 1
TH032 1 TH132 -1 TH232 1 LH032 1 LH132 1 LH232 1
TH035 1 TH135 -1 TH235 1 LH035 1 LH135 1 LH235 1
TH036 1 TH136 -1 TH236 1 LH036 1 LH136 1 LH236 1
TH037 1 TH137 -1 TH237 1 LH037 1 LH137 1 LH237 1
TH039 1 TH139 -1 TH239 1 LH039 1 LH139 1 LH239 1
TH041 1 TH141 -1 TH241 1 LH041 1 LH141 1 LH241 1
TH042 1 TH142 -1 TH242 1 LH042 1 LH142 1 LH242 1
TH043 1 TH143 -1 TH243 1 LH043 1 LH143 1 LH243 1
TH046 1 TH146 -1 TH246 1 LH046 1 LH146 1 LH246 1
TH047 1 TH147 -1 TH247 1 LH047 1 LH147 1 LH247 1
TH049 1 TH149 -1 TH249 1 LH049 1 LH149 1 LH249 1
TH051 1 TH151 -1 TH251 1 LH051 1 LH151 1 LH251 1
TH052 1 TH152 -1 TH252 1 LH052 1 LH152 1 LH252 1
TH053 1 TH153 -1 TH253 1 LH053 1 LH153 1 LH253 1
TH054 1 TH154 -1 TH254 1 LH054 1 LH154 1 LH254 1
TH057 1 TH157 -1 TH257 1 LH057 1 LH157 1 LH257 1
TH059 1 TH159 -1 TH259 1 LH059 1 LH159 1 LH259 1
TH061 1 TH161 -1 TH261 1 LH061 1 LH161 1 LH261 1
TH062 1 TH162 -1 TH262 1 LH062 1 LH162 1 LH262 1
TH063 1 TH163 -1 TH263 1 LH063 1 LH163 1 LH263 1
TH064 1 TH164 -1 TH264 1 LH064 1 LH164 1 LH264 1
TH065 1 TH165 -1 TH265 1 LH065 1 LH165 1 LH265 1
TH069 1 TH169 -1 TH269 1 LH069 1 LH169 1 LH269 1
TH071 1 TH171 -1 TH271 1 LH071 1 LH171 1 LH271 1
TH072 1 TH172 -1 TH272 1 LH072 1 LH172 1 LH272 1
TH073 1 TH173 -1 TH273 1 LH073 1 LH173 1 LH273 1
TH074 1 TH174 -1 TH274 1 LH074 1 LH174 1 LH274 1
TH075 1 TH175 -1 TH275 1 LH075 1 LH175 1 LH275 1
TH076 1 TH176 -1 TH276 1 LH076 1 LH176 1 LH276 1
                         LH079 1 LH179 1 LH279 1
                         LH091 1 LH191 1 LH291 1
TH092 1 TH192 -1 TH292 1 LH092 1 LH192 1 LH292 1
TH093 1 TH193 -1 TH293 1 LH093 1 LH193 1 LH293 1
TH094 1 TH194 -1 TH294 1 LH094 1 LH194 1 LH294 1
TH095 1 TH195 -1 TH295 1 LH095 1 LH195 1 LH295 1
TH096 1 TH196 -1 TH296 1 LH096 1 LH196 1 LH296 1
TH097 1 TH197 -1 TH297 1 LH097 1 LH197 1 LH297 1
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LH012 1 LH112 -1 LH212 1 LH023 1 LH123 1 LH223 1
LH034 1 LH134 -1 LH234 1 LH045 1 LH145 1 LH245 1
LH056 1 LH156 -1 LH256 1 LH067 1 LH167 1 LH267 1);
/*
```

APPENDIX H
COMPUTER PROGRAM FOR ALL SIMULATIONS

APPENDIX H

COMPUTER PROGRAM FOR SIMULATIONS ON THE WORLD TRADE SYSTEM FOR FRESH VEGETABLES

```
//SIMLATE2 JOB (1001,1291,25,10,0),FITZ,CLASS=2
/*PASSWORD    1,JNDPBJ
/*ROUTE  PRINT N1RO
//  EXEC SAS
//AMY      DD DSN=UF.D0011204.SASBASE,DISP=(OLD,KEEP)
//SYSIN DD *
*********************************************
****  SIMULATIONS :EQUATION BY EQUATION  ***
****  MACRO FOR EXPORTS ADJUSTED TO ONLY ***
****  ALLOW PRODUCTION TO GROW LINEARLY  ***
****  IN REGION 6--THEREFORE ITS INTERCEPT**
****  IS CHANGED FROM REGRESSION RESULTS ***
***                                      ***
*** FILE= SIMLATE4 JOB                   ***
*********************************************;
MACRO ZEQDZ;
IQ1D = EXP(17.019 - .455*LOG(MP1D/ACPI2)
                  + .430*LOG(GDP1/ACPI2)
                  - .234*LOG(POP1));
IQ2D = EXP(15.144 - .431*LOG(MP2D/ACPI2)
                  + .642*LOG(GDP2/ACPI2)
                  - .528*LOG(POP2));
IQ3D = EXP(3.179 + .117*LOG(MP3D/ACPI2)
                 -1.115*LOG(GDP3/ACPI2)
                 + 5.552*LOG(POP3));
IQ4D = EXP(14.205 - .722*LOG(MP4D/ACPI2)
                  + .153*LOG(GDP4/ACPI2)
                  + .272*LOG(POP4));
IQ5D = EXP(48.222 - 1.781*LOG(MP5D/ACPI2)
                  + 3.119*LOG(GDP5/ACPI2)
                  - 9.481*LOG(POP5));
IQ6D = EXP(14.506 + .204*LOG(MP6D/ACPI2)
                  - .023*LOG(GDP6/ACPI2)
                  + .780*LOG(POP6));
IQ7D = EXP(12.475 + .011*LOG(MP7D/ACPI2)
                  - .033*LOG(GDP7/ACPI2)
                  + 1.009*LOG(POP7));
IQ9D = EXP(11.417 - .113*LOG(MP9D/ACPI2)
                  + .045*LOG(GDP9/ACPI2)
                  + 1.027*LOG(POP9));
TOTALD = SUM(IQ1D,IQ2D,IQ3D,IQ4D,IQ5D,IQ6D,IQ7D,IQ9D);
```

```
SHARE1 = IQ1D/TOTALD;
SHARE2 = IQ2D/TOTALD;
SHARE3 = IQ3D/TOTALD;
SHARE4 = IQ4D/TOTALD;
SHARE5 = IQ5D/TOTALD;
SHARE6 = IQ6D/TOTALD;
SHARE7 = IQ7D/TOTALD;
SHARE9 = IQ9D/TOTALD;
%
MACRO ZEQPDZ;
IQ13=EXP(-7.394 + 1.810*LOG(MP13/MP1D) + 1.029*LOG(IQ1D));
IQ14=EXP(-35.154 + .481*LOG(MP14/MP1D) + 2.577*LOG(IQ1D));
IQ19=EXP(-55.81 - 1.173*LOG(MP19/MP1D) + 3.691*LOG(IQ1D));
IQ21=EXP(-58.717-.620*LOG(MP21/MP2D) + 4.131*LOG(IQ2D));
IQ24=EXP(11.290-.086*LOG(MP24/MP2D) - .098*LOG(IQ2D));
IQ31=EXP(4.487 - .537*LOG(MP31/MP3D) + .416*LOG(IQ3D));
IQ32=EXP(-4.513 - .523*LOG(MP32/MP3D) + 1.162*LOG(IQ3D));
IQ41=EXP(70.262 - .28*LOG(MP41/MP4D) - 3.240*LOG(IQ4D));
IQ42=EXP(7.708 - 4.079*LOG(MP42/MP4D) +.393*LOG(IQ4D));
IQ43=EXP(-5.653 + 3.823*LOG(MP43/MP4D) +.811*LOG(IQ4D));
IQ46=EXP(27.181 - 3.921*LOG(MP46/MP4D) - .838*LOG(IQ4D));
IQ47=EXP(13.533 - .400*LOG(MP47/MP4D) - .004*LOG(IQ4D));
IQ49=EXP(15.036 + 1.851*LOG(MP49/MP4D) - .140*LOG(IQ4D));
IQ52=EXP(-8.275 - 1.841*LOG(MP52/MP5D) + 1.077*LOG(IQ5D));
IQ54=EXP(-19.783 - 2.131*LOG(MP54/MP5D) + 1.808*LOG(IQ5D));
IQ57=EXP(-3.697 - 2.476*LOG(MP57/MP5D) + .860*LOG(IQ5D));
IQ59=EXP(-2.534 - 2.156*LOG(MP59/MP5D) + .739*LOG(IQ5D));
IQ62=EXP(-81.495 +.955*LOG(MP62/MP6D) + 4.716*LOG(IQ6D));
IQ64=EXP(-53.518 - 1.262*LOG(MP64/MP6D) + 3.285*LOG(IQ6D));
IQ65=EXP(49.839 - 2.888*LOG(MP65/MP6D) - 2.136*LOG(IQ6D));
IQ69=EXP(-85.097-.005*LOG(MP69/MP6D) + 4.742*LOG(IQ6D));
IQ72=EXP(-55.215-2.567*LOG(MP72/MP7D) +3.684*LOG(IQ7D));
IQ74=EXP(-31.334-1.550*LOG(MP74/MP7D)+ 2.391*LOG(IQ7D));
IQ75=EXP(-121.79 + .412*LOG(MP75/MP7D) + 7.234*LOG(IQ7D));
IQ76=EXP(-49.322 - 1.277*LOG(MP76/MP7D) + 3.142*LOG(IQ7D));
IQ92=EXP(-13.249 - 5.348*LOG(MP92/MP9D) + 1.529*LOG(IQ9D));
IQ93=EXP(4.671 + 3.706*LOG(MP93/MP9D) + .353*LOG(IQ9D));
IQ94=EXP(14.467 + 2.704*LOG(MP94/MP9D) - .106*LOG(IQ9D));
IQ95=EXP(-52.299 - 3.484*LOG(MP95/MP9D) + 3.729*LOG(IQ9D));
IQ96=EXP(137.337 - .070*LOG(MP96/MP9D) - 7.623*LOG(IQ9D));
IQ97=EXP(-95.287 - 4.773*LOG(MP97/MP9D) + 6.293*LOG(IQ9D));
SHARE13 = IQ13/IQ1D;
SHARE14 = IQ14/IQ1D;
SHARE19 = IQ19/IQ1D;
SHARE21 = IQ21/IQ2D;
SHARE24 = IQ24/IQ2D;
SHARE31 = IQ31/IQ3D;
SHARE32 = IQ32/IQ3D;
SHARE41 = IQ41/IQ4D;
SHARE42 = IQ42/IQ4D;
SHARE43 = IQ43/IQ4D;
SHARE46 = IQ46/IQ4D;
SHARE47 = IQ47/IQ4D;
SHARE49 = IQ49/IQ4D;
```

```
SHARE52 = IQ52/IQ5D;
SHARE54 = IQ54/IQ5D;
SHARE57 = IQ57/IQ5D;
SHARE59 = IQ59/IQ5D;
SHARE62 = IQ62/IQ6D;
SHARE64 = IQ64/IQ6D;
SHARE65 = IQ65/IQ6D;
SHARE69 = IQ69/IQ6D;
SHARE72 = IQ72/IQ7D;
SHARE74 = IQ74/IQ7D;
SHARE75 = IQ75/IQ7D;
SHARE76 = IQ76/IQ7D;
SHARE92 = IQ92/IQ9D;
SHARE93 = IQ93/IQ9D;
SHARE94 = IQ94/IQ9D;
SHARE95 = IQ95/IQ9D;
SHARE96 = IQ96/IQ9D;
SHARE97 = IQ97/IQ9D;
%
MACRO ZEQSZ;
EXPORT1=EXP(-30.476 + .427*LOG(EPD1) + 2.478*LOG(PRD1));
EXPORT2=EXP(31.663 + 1.504*LOG(EPD2) - .901*LOG(PRD2));
EXPORT3=EXP(.185 + .192*LOG(EPD3) + .835*LOG(PRD3));
EXPORT4=EXP(5.407 + .156*LOG(EPD4) + .472*LOG(PRD4));
EXPORT5=EXP(3.159 + .015*LOG(EPD5) + .570*LOG(PRD5));
EXPORT6=EXP(LOG(.002531) - 5.429*LOG(EPD6) +
1.000*LOG(PRD6));
EXPORT7=EXP(52.711 + .243*LOG(EPD7) - 2.136*LOG(PRD7));
EXPORT9=EXP(3.589 + .593*LOG(EPD9) + .625*LOG(PRD9));
TOTALS = SUM(EXPORT1,EXPORT2,EXPORT3,EXPORT4,EXPORT5,
         EXPORT6,EXPORT7,EXPORT9);
SSHARE1 = EXPORT1/TOTALS;
SSHARE2 = EXPORT2/TOTALS;
SSHARE3 = EXPORT3/TOTALS;
SSHARE4 = EXPORT4/TOTALS;
SSHARE5 = EXPORT5/TOTALS;
SSHARE6 = EXPORT6/TOTALS;
SSHARE7 = EXPORT7/TOTALS;
SSHARE9 = EXPORT9/TOTALS;
%
MACRO ZCIFZ;
IP12 = EXP(-103.57 + .690*LOG(EP21) + 13.625*LOG(YEAR));
IP13 = EXP(-889.77 + .523*LOG(EP31) + 117.201*LOG(YEAR));
IP14 = EXP(8.494 + .995*LOG(EP41) - 1.074*LOG(YEAR));
IP19 = EXP(-535.28 + .655*LOG(EP91) + 70.573*LOG(YEAR));
IP21 = EXP(-1267.4 - .348*LOG(EP12) + 166.793*LOG(YEAR));
IP23 = EXP(-142.78 + .842*LOG(EP12) + 18.762*LOG(YEAR));
IP24 = EXP(-101.75 + .921*LOG(EP42) + 13.416*LOG(YEAR));
IP31 = EXP(-1495.7 - .372*LOG(EP13) + 196.89*LOG(YEAR));
IP32 = EXP(-462.12 + .781*LOG(EP23) + 60.883*LOG(YEAR));
IP41 = EXP(37.021 + 1.164*LOG(EP14) - 4.825*LOG(YEAR));
IP42 = EXP(-494.16 + .558*LOG(EP24) + 65.081*LOG(YEAR));
IP43 = EXP(142.453 + .993*LOG(EP34) -18.75*LOG(YEAR));
IP45 = EXP(-1393.1 - .530*LOG(EP54) + 183.344*LOG(YEAR));
```

```
IP46 = EXP(637.234 + 1.241*LOG(EP64) - 83.852*LOG(YEAR));
IP47 = EXP(-97.56 + 1.202*LOG(EP74) + 12.933*LOG(YEAR));
IP49 = EXP(468.405 + 1.217*LOG(EP94) - 61.637*LOG(YEAR));
IP52 = EXP(383.056 + 1.775*LOG(EP25) - 50.389*LOG(YEAR));
IP54 = EXP(104.549 + 1.017*LOG(EP45) - 13.74*LOG(YEAR));
IP57 = EXP(-359.91 + 1.047*LOG(EP75) + 47.512*LOG(YEAR));
IP59 = EXP(-1018.2 + .958*LOG(EP95) + 134.235*LOG(YEAR));
IP62 = EXP(-469.38 + .752*LOG(EP26) + 61.85*LOG(YEAR));
IP64 = EXP(313.841 + 1.318*LOG(EP46) - 41.259*LOG(YEAR));
IP65 = EXP(-785.43 - .150*LOG(EP56) + 103.358*LOG(YEAR));
IP69 = EXP(-133.92 + .603*LOG(EP96) + 17.633*LOG(YEAR));
IP72 = EXP(-738.76 - .016*LOG(EP27) + 97.282*LOG(YEAR));
IP74 = EXP(-191.79 + .738*LOG(EP47) + 25.249*LOG(YEAR));
IP75 = EXP(165.84 + .749*LOG(EP57) -21.911*LOG(YEAR));
IP76 = EXP(81.418 + .916*LOG(EP67) -10.692*LOG(YEAR));
IP92 = EXP(142.024 + 1.28*LOG(EP29) - 18.64*LOG(YEAR));
IP93 = EXP(-411.23 + .5637*LOG(EP39) + 54.142*LOG(YEAR));
IP94 = EXP(56.409 + .989*LOG(EP49) - 7.421*LOG(YEAR));
IP95 = EXP(-925.16 + .622*LOG(EP59) + 121.89*LOG(YEAR));
IP96 = EXP(-549.32 + 1.139*LOG(EP69) + 72.529*LOG(YEAR));
IP97 = EXP(-506.75 + .806*LOG(EP79) + 66.791*LOG(YEAR));
%
DATA AA; SET AMY.SYSNDAT;
IF YEAR = 1982;
POP1= 463.34;GDP1=265.97;
XMP1D=MP1D;
XMP2D=MP2D;
XMP3D=MP3D;
XMP4D=MP4D;
XMP5D=MP5D;
XMP6D=MP6D;
XMP7D=MP7D;
XMP9D=MP9D;
XPOP1=POP1;
XPOP2=POP2;
XPOP3=POP3;
XPOP4=POP4;
XPOP5=POP5;
XPOP6=POP6;
XPOP7=POP7;
XPOP9=POP9;
XGDP1=GDP1;
XGDP2=GDP2;
XGDP3=GDP3;
XGDP4=GDP4;
XGDP5=GDP5;
XGDP6=GDP6;
XGDP7=GDP7;
XGDP9=GDP9;
XEPD1=EPD1;
XEPD2=EPD2;
XEPD3=EPD3;
XEPD4=EPD4;
XEPD5=EPD5;
```

```
XEPD6=EPD6;
XEPD7=EPD7;
XEPD9=EPD9;
XPRD1=PRD1;
XPRD2=PRD2;
XPRD3=PRD3;
XPRD4=PRD4;
XPRD5=PRD5;
XPRD6=PRD6;
XPRD7=PRD7;
XPRD9=PRD9;
XMP13=MP13;
XMP14=MP14;
XMP19=MP19;
XMP21=MP21;
XMP24=MP24;
XMP31=MP31;
XMP32=MP32;
XMP41=MP41;
XMP42=MP42;
XMP43=MP43;
XMP46=MP46;
XMP47=MP47;
XMP49=MP49;
XMP52=MP52;
XMP54=MP54;
XMP57=MP57;
XMP59=MP59;
XMP62=MP62;
XMP64=MP64;
XMP65=MP65;
XMP69=MP69;
XMP72=MP72;
XMP74=MP74;
XMP75=MP75;
XMP76=MP76;
XMP92=MP92;
XMP93=MP93;
XMP94=MP94;
XMP95=MP95;
XMP96=MP96;
XMP97=MP97;
KEEP YEAR ACPI2 IQ1D MP1D GDP1 POP1
           IQ2D MP2D GDP2 POP2
           IQ3D MP3D GDP3 POP3
           IQ4D MP4D GDP4 POP4
           IQ5D MP5D GDP5 POP5
           IQ6D MP6D GDP6 POP6
           IQ7D MP7D GDP7 POP7
           IQ9D MP9D GDP9 POP9
IQ13 MP13 IQ14 MP14
IQ19 MP19 IQ21 MP21
IQ24 MP24 IQ31 MP31
IQ32 MP32 IQ41 MP41
```

```
IQ42 MP42 IQ43 MP43
IQ46 MP46 IQ47 MP47
IQ49 MP49 IQ52 MP52
IQ54 MP54 IQ57 MP57
IQ59 MP59 IQ62 MP62
IQ64 MP64 IQ65 MP65
IQ69 MP69 IQ72 MP72
IQ74 MP74 IQ75 MP75
IQ76 MP76 IQ92 MP92
IQ93 MP93 IQ94 MP94
IQ95 MP95 IQ96 MP96
IQ97 MP97
EXPORT1 EPD1 PRD1
EXPORT2 EPD2 PRD2
EXPORT3 EPD3 PRD3
EXPORT4 EPD4 PRD4
EXPORT5 EPD5 PRD5
EXPORT6 EPD6 PRD6
EXPORT7 EPD7 PRD7
EXPORT9 EPD9 PRD9
IP13 EP31 IP14 EP41 IP19 EP91
IP21 EP12 IP24 EP42 IP31 EP13
IP32 EP23 IP41 EP14 IP42 EP24
IP43 EP34 IP46 EP64 IP47 EP74
IP49 EP94 IP52 EP25 IP54 EP45
IP57 EP75 IP59 EP95 IP62 EP26
IP64 EP46 IP65 EP56 IP69 EP96
IP72 EP27 IP74 EP47 IP75 EP57
IP76 EP67 IP92 EP29 IP93 EP39
IP94 EP49 IP95 EP59 IP96 EP69
IP97 EP79 IP12 EP21 IP23 EP32
IP45 EP54
XMP1D XMP2D XMP3D XMP4D XMP5D XMP6D XMP7D XMP9D
XPOP1 XPOP2 XPOP3 XPOP4 XPOP5 XPOP6 XPOP7 XPOP9
XGDP1 XGDP2 XGDP3 XGDP4 XGDP5 XGDP6 XGDP7 XGDP9
XEPD1 XEPD2 XEPD3 XEPD4 XEPD5 XEPD6 XEPD7 XEPD9
XPRD1 XPRD2 XPRD3 XPRD4 XPRD5 XPRD6 XPRD7 XPRD9
XMP13 XMP14 XMP19 XMP21 XMP24 XMP31 XMP32 XMP41
XMP42 XMP43 XMP46 XMP47 XMP49 XMP52 XMP54 XMP57
XMP59 XMP62 XMP64 XMP65 XMP69 XMP72 XMP74 XMP75 XMP76
XMP92 XMP93 XMP94 XMP95 XMP96 XMP97;
DATA BB;  SET AA;
DO I=.5 TO 1.5 BY .1;
ID=1;
MP1D=XMP1D*I;
MP2D=XMP2D*I;
MP3D=XMP3D*I;
MP4D=XMP4D*I;
MP5D=XMP5D*I;
MP6D=XMP6D*I;
MP7D=XMP7D*I;
MP9D=XMP9D*I;
ZEQDZ;ZEQPDZ;OUTPUT;END;
DATA BBB; SET BB;
```

```
IF .999<I<1.0001;
AIQ1D=IQ1D;
AIQ2D=IQ2D;
AIQ3D=IQ3D;
AIQ4D=IQ4D;
AIQ5D=IQ5D;
AIQ6D=IQ6D;
AIQ7D=IQ7D;
AIQ9D=IQ9D;
AIQ13=IQ13;
AIQ14=IQ14;
AIQ19=IQ19;
AIQ21=IQ21;
AIQ24=IQ24;
AIQ31=IQ31;
AIQ32=IQ32;
AIQ41=IQ41;
AIQ42=IQ42;
AIQ43=IQ43;
AIQ46=IQ46;
AIQ47=IQ47;
AIQ49=IQ49;
AIQ52=IQ52;
AIQ54=IQ54;
AIQ57=IQ57;
AIQ59=IQ59;
AIQ62=IQ62;
AIQ64=IQ64;
AIQ65=IQ65;
AIQ69=IQ69;
AIQ72=IQ72;
AIQ74=IQ74;
AIQ75=IQ75;
AIQ76=IQ76;
AIQ92=IQ92;
AIQ93=IQ93;
AIQ94=IQ94;
AIQ95=IQ95;
AIQ96=IQ96;
AIQ97=IQ97;
KEEP ID AIQ1D AIQ2D AIQ3D AIQ4D AIQ5D AIQ6D
     AIQ7D AIQ9D
     AIQ13 AIQ14 AIQ19 AIQ21 AIQ24 AIQ31 AIQ32
     AIQ41 AIQ42 AIQ43 AIQ46 AIQ47 AIQ49 AIQ52
     AIQ54 AIQ57 AIQ59 AIQ62 AIQ64 AIQ65 AIQ69
     AIQ72 AIQ74 AIQ75 AIQ76 AIQ92 AIQ93 AIQ94
     AIQ95 AIQ96 AIQ97;
PROC SORT;BY ID;
PROC SORT DATA = BB;BY ID;
DATA BB; MERGE BB BBB; BY ID;
RIQ1D=IQ1D/AIQ1D;
RIQ2D=IQ2D/AIQ2D;
RIQ3D=IQ3D/AIQ3D;
RIQ4D=IQ4D/AIQ4D;
```

```
RIQ5D=IQ5D/AIQ5D;
RIQ6D=IQ6D/AIQ6D;
RIQ7D=IQ7D/AIQ7D;
RIQ9D=IQ9D/AIQ9D;
RIQ13=IQ13/AIQ13;
RIQ14=IQ14/AIQ14;
RIQ19=IQ19/AIQ19;
RIQ21=IQ21/AIQ21;
RIQ24=IQ24/AIQ24;
RIQ31=IQ31/AIQ31;
RIQ32=IQ32/AIQ32;
RIQ41=IQ41/AIQ41;
RIQ42=IQ42/AIQ42;
RIQ43=IQ43/AIQ43;
RIQ46=IQ46/AIQ46;
RIQ47=IQ47/AIQ47;
RIQ49=IQ49/AIQ49;
RIQ52=IQ52/AIQ52;
RIQ54=IQ54/AIQ54;
RIQ57=IQ57/AIQ57;
RIQ59=IQ59/AIQ59;
RIQ62=IQ62/AIQ62;
RIQ64=IQ64/AIQ64;
RIQ65=IQ65/AIQ65;
RIQ69=IQ69/AIQ69;
RIQ72=IQ72/AIQ72;
RIQ74=IQ74/AIQ74;
RIQ75=IQ75/AIQ75;
RIQ76=IQ76/AIQ76;
RIQ92=IQ92/AIQ92;
RIQ93=IQ93/AIQ93;
RIQ94=IQ94/AIQ94;
RIQ95=IQ95/AIQ95;
RIQ96=IQ96/AIQ96;
RIQ97=IQ97/AIQ97;
PROC PRINT;
VAR ID MP1D MP2D MP3D MP4D MP5D MP6D MP7D MP9D
    IQ1D IQ2D IQ3D IQ4D IQ5D IQ6D IQ7D IQ9D
    IQ13 IQ14 IQ19 IQ21 IQ24 IQ31 IQ32 IQ41
    IQ42 IQ43 IQ46 IQ47 IQ49 IQ52 IQ54 IQ57
    IQ59 IQ62 IQ64 IQ65 IQ69 IQ72 IQ74 IQ75
    IQ76 IQ92 IQ93 IQ94 IQ95 IQ96 IQ97
    AIQ1D AIQ2D AIQ3D AIQ4D AIQ5D AIQ6D AIQ7D AIQ9D
    RIQ1D RIQ2D RIQ3D RIQ4D RIQ5D RIQ6D RIQ7D RIQ9D
    AIQ13 AIQ14 AIQ19 AIQ21 AIQ24 AIQ31 AIQ32
    AIQ41 AIQ42 AIQ43 AIQ46 AIQ47 AIQ49 AIQ52
    AIQ54 AIQ57 AIQ59 AIQ62 AIQ64 AIQ65 AIQ69 AIQ72
    AIQ74 AIQ75 AIQ76 AIQ92 AIQ93 AIQ94 AIQ95
    AIQ96 AIQ97
    RIQ13 RIQ14 RIQ19 RIQ21 RIQ24 RIQ31 RIQ32 RIQ41
    RIQ42 RIQ43 RIQ46 RIQ47 RIQ49 RIQ52 RIQ54 RIQ57
    RIQ59 RIQ62 RIQ64 RIQ65 RIQ69 RIQ72 RIQ74 RIQ75
    RIQ76 RIQ92 RIQ93 RIQ94 RIQ95 RIQ96 RIQ97
SHARE1 SHARE2 SHARE3 SHARE4 SHARE5 SHARE6 SHARE7 SHARE9
```

```
SHARE13 SHARE14 SHARE19 SHARE21 SHARE24 SHARE31 SHARE41
SHARE42 SHARE43 SHARE46 SHARE47 SHARE49 SHARE52 SHARE54
SHARE57 SHARE59 SHARE62 SHARE64 SHARE65 SHARE69 SHARE72
SHARE74 SHARE75 SHARE76 SHARE92 SHARE93 SHARE94 SHARE95
SHARE96 SHARE97 SHARE32;
DATA CC;SET AA;
DO I=0 TO 10 BY 1.0;
ID=1;
POP1=XPOP1*(1+I*.03);
POP5=XPOP5*(1+I*.03);
POP7=XPOP7*(1+I*.03);
POP6=XPOP6*(1+I*.04);
POP2=XPOP2*(1+I*.01);
POP3=XPOP3*(1+I*.01);
POP4=XPOP4*(1+I*.01);
POP9=XPOP9*(1+I*.005);
GDP1=XGDP1*(1+I*.01);
GDP2=XGDP2*(1+I*.08);
GDP3=XGDP3*(1+I*.04);
GDP4=XGDP4*(1+I*.10);
GDP5=XGDP5*(1+I*.30);
GDP6=XGDP6*(1+I*.20);
GDP7=XGDP7*(1+I*.20);
GDP9=XGDP9*(1+I*.20);
ZEQDZ; ZEQPDZ;OUTPUT;END;
DATA CCC; SET CC;
IF I=0;
AIQ1D=IQ1D;
AIQ2D=IQ2D;
AIQ3D=IQ3D;
AIQ4D=IQ4D;
AIQ5D=IQ5D;
AIQ6D=IQ6D;
AIQ7D=IQ7D;
AIQ9D=IQ9D;
AIQ13=IQ13;
AIQ14=IQ14;
AIQ19=IQ19;
AIQ21=IQ21;
AIQ24=IQ24;
AIQ31=IQ31;
AIQ32=IQ32;
AIQ41=IQ41;
AIQ42=IQ42;
AIQ43=IQ43;
AIQ46=IQ46;
AIQ47=IQ47;
AIQ49=IQ49;
AIQ52=IQ52;
AIQ54=IQ54;
AIQ57=IQ57;
AIQ59=IQ59;
AIQ62=IQ62;
AIQ64=IQ64;
```

```
AIQ65=IQ65;
AIQ69=IQ69;
AIQ72=IQ72;
AIQ74=IQ74;
AIQ75=IQ75;
AIQ76=IQ76;
AIQ92=IQ92;
AIQ93=IQ93;
AIQ94=IQ94;
AIQ95=IQ95;
AIQ96=IQ96;
AIQ97=IQ97;
KEEP ID AIQ1D AIQ2D AIQ3D AIQ4D AIQ5D AIQ6D AIQ7D AIQ9D
        AIQ13 AIQ14 AIQ19 AIQ21 AIQ24 AIQ31 AIQ32 AIQ41
        AIQ42 AIQ43 AIQ46 AIQ47 AIQ49 AIQ52 AIQ54 AIQ57
        AIQ59 AIQ62 AIQ64 AIQ65 AIQ69 AIQ72 AIQ74 AIQ75
        AIQ76 AIQ92 AIQ93 AIQ94 AIQ95 AIQ96 AIQ97;
PROC SORT; BY ID;
PROC SORT DATA=CC;BY ID;
DATA CC;MERGE CC CCC; BY ID;
RIQ1D=IQ1D/AIQ1D;
RIQ2D=IQ2D/AIQ2D;
RIQ3D=IQ3D/AIQ3D;
RIQ4D=IQ4D/AIQ4D;
RIQ5D=IQ5D/AIQ5D;
RIQ6D=IQ6D/AIQ6D;
RIQ7D=IQ7D/AIQ7D;
RIQ9D=IQ9D/AIQ9D;
RIQ13=IQ13/AIQ13;
RIQ14=IQ14/AIQ14;
RIQ19=IQ19/AIQ19;
RIQ21=IQ21/AIQ21;
RIQ24=IQ24/AIQ24;
RIQ31=IQ31/AIQ31;
RIQ32=IQ32/AIQ32;
RIQ41=IQ41/AIQ41;
RIQ42=IQ42/AIQ42;
RIQ43=IQ43/AIQ43;
RIQ46=IQ46/AIQ46;
RIQ47=IQ47/AIQ47;
RIQ49=IQ49/AIQ49;
RIQ52=IQ52/AIQ52;
RIQ54=IQ54/AIQ54;
RIQ57=IQ57/AIQ57;
RIQ59=IQ59/AIQ59;
RIQ62=IQ62/AIQ62;
RIQ64=IQ64/AIQ64;
RIQ65=IQ65/AIQ65;
RIQ69=IQ69/AIQ69;
RIQ72=IQ72/AIQ72;
RIQ74=IQ74/AIQ74;
RIQ75=IQ75/AIQ75;
RIQ76=IQ76/AIQ76;
RIQ92=IQ92/AIQ92;
```

```
RIQ93=IQ93/AIQ93;
RIQ94=IQ94/AIQ94;
RIQ95=IQ95/AIQ95;
RIQ96=IQ96/AIQ96;
RIQ97=IQ97/AIQ97;
PROC PRINT;
VAR ID POP1 POP2 POP3 POP4 POP5 POP6 POP7 POP9
    GDP1 GDP2 GDP3 GDP4 GDP5 GDP6 GDP7 GDP9
    IQ1D IQ2D IQ3D IQ4D IQ5D IQ6D IQ7D IQ9D
    IQ13 IQ14 IQ19 IQ21 IQ24 IQ31 IQ32 IQ41
    IQ42 IQ43 IQ46 IQ47 IQ49 IQ52 IQ54 IQ57
    IQ59 IQ62 IQ64 IQ65 IQ69 IQ72 IQ74 IQ75
    IQ76 IQ92 IQ93 IQ94 IQ95 IQ96 IQ97
AIQ1D AIQ2D AIQ3D AIQ4D AIQ5D AIQ6D AIQ7D AIQ9D
AIQ13 AIQ14 AIQ19 AIQ21 AIQ24 AIQ31 AIQ32 AIQ41
AIQ42 AIQ43 AIQ46 AIQ47 AIQ49 AIQ52 AIQ54 AIQ57
AIQ59 AIQ62 AIQ64 AIQ65 AIQ69 AIQ72 AIQ74 AIQ75
AIQ76 AIQ92 AIQ93 AIQ94 AIQ95 AIQ96 AIQ97
RIQ1D RIQ2D RIQ3D RIQ4D RIQ5D RIQ6D RIQ7D RIQ9D
RIQ13 RIQ14 RIQ19 RIQ21 RIQ24 RIQ31 RIQ32 RIQ41
RIQ42 RIQ43 RIQ46 RIQ47 RIQ49 RIQ52 RIQ54 RIQ57
RIQ59 RIQ62 RIQ64 RIQ65 RIQ69 RIQ72 RIQ74 RIQ75
RIQ76 RIQ92 RIQ93 RIQ94 RIQ95 RIQ96 RIQ97
SHARE1 SHARE2 SHARE3 SHARE4 SHARE5 SHARE6 SHARE7 SHARE9
SHARE13 SHARE14 SHARE19 SHARE21 SHARE24 SHARE31 SHARE32
SHARE41 SHARE42 SHARE43 SHARE46 SHARE47 SHARE49 SHARE52
SHARE54 SHARE57 SHARE59 SHARE62 SHARE64 SHARE65 SHARE69
SHARE72 SHARE74 SHARE75 SHARE76 SHARE92 SHARE93 SHARE94
SHARE95 SHARE96 SHARE97;
DATA DD;SET AA;
DO I =0 TO 10 BY 1.0;
ID=1;
POP1=XPOP1*(1+I*.03);
POP5=XPOP5*(1+I*.03);
POP7=XPOP7*(1+I*.03);
POP6=XPOP6*(1+I*.04);
POP2=XPOP2*(1+I*.01);
POP3=XPOP3*(1+I*.01);
POP4=XPOP4*(1+I*.01);
POP9=XPOP9*(1+I*.005);
GDP1=XGDP1*(1+I*.03);
GDP2=XGDP2*(1+I*.03);
GDP3=XGDP3*(1+I*.03);
GDP4=XGDP4*(1+I*.03);
GDP5=XGDP5*(1+I*.03);
GDP6=XGDP6*(1+I*.03);
GDP7=XGDP7*(1+I*.03);
GDP9=XGDP9*(1+I*.03);
ZEQDZ;ZEQPDZ;OUTPUT;END;
DATA DDD; SET DD;
IF I=0;
AIQ1D=IQ1D;
AIQ2D=IQ2D;
AIQ3D=IQ3D;
```

```
AIQ4D=IQ4D;
AIQ5D=IQ5D;
AIQ6D=IQ6D;
AIQ7D=IQ7D;
AIQ9D=IQ9D;
AIQ13=IQ13;
AIQ14=IQ14;
AIQ19=IQ19;
AIQ21=IQ21;
AIQ24=IQ24;
AIQ31=IQ31;
AIQ32=IQ32;
AIQ41=IQ41;
AIQ42=IQ42;
AIQ43=IQ43;
AIQ46=IQ46;
AIQ47=IQ47;
AIQ49=IQ49;
AIQ52=IQ52;
AIQ54=IQ54;
AIQ57=IQ57;
AIQ59=IQ59;
AIQ62=IQ62;
AIQ64=IQ64;
AIQ65=IQ65;
AIQ69=IQ69;
AIQ72=IQ72;
AIQ74=IQ74;
AIQ75=IQ75;
AIQ76=IQ76;
AIQ92=IQ92;
AIQ93=IQ93;
AIQ94=IQ94;
AIQ95=IQ95;
AIQ96=IQ96;
AIQ97=IQ97;
KEEP ID AIQ1D AIQ2D AIQ3D AIQ4D AIQ5D AIQ6D AIQ7D AIQ9D
AIQ13 AIQ14 AIQ19 AIQ21 AIQ24 AIQ31 AIQ32 AIQ41 AIQ42
AIQ43 AIQ46 AIQ47 AIQ49 AIQ52 AIQ54 AIQ57 AIQ59 AIQ62
AIQ64 AIQ65 AIQ69 AIQ72 AIQ74 AIQ75 AIQ76 AIQ92 AIQ93 AIQ94
AIQ95 AIQ96 AIQ97;
PROC SORT;BY ID;
PROC SORT DATA = DD; BY ID;
DATA DD; MERGE DD DDD; BY ID;
RIQ1D=IQ1D/AIQ1D;
RIQ2D=IQ2D/AIQ2D;
RIQ3D=IQ3D/AIQ3D;
RIQ4D=IQ4D/AIQ4D;
RIQ5D=IQ5D/AIQ5D;
RIQ6D=IQ6D/AIQ6D;
RIQ7D=IQ7D/AIQ7D;
RIQ9D=IQ9D/AIQ9D;
RIQ13=IQ13/AIQ13;
RIQ14=IQ14/AIQ14;
```

```
RIQ19=IQ19/AIQ19;
RIQ21=IQ21/AIQ21;
RIQ24=IQ24/AIQ24;
RIQ31=IQ31/AIQ31;
RIQ32=IQ32/AIQ32;
RIQ41=IQ41/AIQ41;
RIQ42=IQ42/AIQ42;
RIQ43=IQ43/AIQ43;
RIQ46=IQ46/AIQ46;
RIQ47=IQ47/AIQ47;
RIQ49=IQ49/AIQ49;
RIQ52=IQ52/AIQ52;
RIQ54=IQ54/AIQ54;
RIQ57=IQ57/AIQ57;
RIQ59=IQ59/AIQ59;
RIQ62=IQ62/AIQ62;
RIQ64=IQ64/AIQ64;
RIQ65=IQ65/AIQ65;
RIQ69=IQ69/AIQ69;
RIQ72=IQ72/AIQ72;
RIQ74=IQ74/AIQ74;
RIQ75=IQ75/AIQ75;
RIQ76=IQ76/AIQ76;
RIQ92=IQ92/AIQ92;
RIQ93=IQ93/AIQ93;
RIQ94=IQ94/AIQ94;
RIQ95=IQ95/AIQ95;
RIQ96=IQ96/AIQ96;
RIQ97=IQ97/AIQ97;
PROC PRINT;
VAR ID POP1 POP2 POP3 POP4 POP5 POP6 POP7 POP9
    GDP1 GDP2 GDP3 GDP4 GDP5 GDP6 GDP7 GDP9
IQ1D IQ2D IQ3D IQ4D IQ5D IQ6D IQ7D IQ9D
IQ13 IQ14 IQ19 IQ21 IQ24 IQ31 IQ32 IQ41 IQ42
IQ43 IQ46 IQ47 IQ49 IQ52 IQ54 IQ57 IQ59 IQ62
IQ64 IQ65 IQ69 IQ72 IQ74 IQ75 IQ76 IQ92 IQ93
IQ94 IQ95 IQ96 IQ97
AIQ1D AIQ2D AIQ3D AIQ4D AIQ5D AIQ6D AIQ7D AIQ9D
AIQ13 AIQ14 AIQ19 AIQ21 AIQ24 AIQ31 AIQ32 AIQ41
AIQ42 AIQ43 AIQ46 AIQ47 AIQ49 AIQ52 AIQ54 AIQ57
AIQ59 AIQ62 AIQ64 AIQ65 AIQ69 AIQ72 AIQ74 AIQ75
AIQ76 AIQ92 AIQ93 AIQ94 AIQ95 AIQ96 AIQ97
RIQ1D RIQ2D RIQ3D RIQ4D RIQ5D RIQ6D RIQ7D RIQ9D
RIQ13 RIQ14 RIQ19 RIQ21 RIQ24 RIQ31 RIQ32 RIQ41
RIQ42 RIQ43 RIQ46 RIQ47 RIQ49 RIQ52 RIQ54 RIQ57
RIQ59 RIQ62 RIQ64 RIQ65 RIQ69 RIQ72 RIQ74 RIQ75
RIQ76 RIQ92 RIQ93 RIQ94 RIQ95 RIQ96 RIQ97
SHARE1 SHARE2 SHARE3 SHARE4 SHARE5 SHARE6 SHARE7 SHARE9
SHARE13 SHARE14 SHARE19 SHARE21 SHARE24 SHARE31 SHARE32
SHARE41 SHARE42 SHARE43 SHARE46 SHARE47 SHARE49 SHARE52
SHARE54 SHARE57 SHARE59 SHARE62 SHARE64 SHARE65 SHARE69
SHARE72 SHARE74 SHARE75 SHARE76 SHARE92 SHARE93 SHARE94
SHARE95 SHARE96 SHARE97;
DATA EE; SET AA;
```

```
DO I =.50 TO 1.50 BY .10;
ID=1;
EPD1=XEPD1*I;
EPD2=XEPD2*I;
EPD3=XEPD3*I;
EPD4=XEPD4*I;
EPD5=XEPD5*I;
EPD6=XEPD6*I;
EPD7=XEPD7*I;
EPD9=XEPD9*I;
ZEQSZ;OUTPUT;END;
DATA EEE; SET EE;
IF .999<I<1.0001;
AEXPORT1=EXPORT1;
AEXPORT2=EXPORT2;
AEXPORT3=EXPORT3;
AEXPORT4=EXPORT4;
AEXPORT5=EXPORT5;
AEXPORT6=EXPORT6;
AEXPORT7=EXPORT7;
AEXPORT9=EXPORT9;
ASSHARE1=SSHARE1;
ASSHARE2=SSHARE2;
ASSHARE3=SSHARE3;
ASSHARE4=SSHARE4;
ASSHARE5=SSHARE5;
ASSHARE6=SSHARE6;
ASSHARE7=SSHARE7;
ASSHARE9=SSHARE9;
ATOTALS=TOTALS;
KEEP ID AEXPORT1 AEXPORT2 AEXPORT3 AEXPORT4 AEXPORT5
AEXPORT6 AEXPORT7 AEXPORT9
ASSHARE1 ASSHARE2 ASSHARE3 ASSHARE4 ASSHARE5 ASSHARE6
ASSHARE7 ASSHARE9
ATOTALS;
PROC SORT; BY ID;
PROC SORT DATA=EE; BY ID;
DATA EE;MERGE EE EEE; BY ID;
REXPORT1=EXPORT1/AEXPORT1;
REXPORT2=EXPORT2/AEXPORT2;
REXPORT3=EXPORT3/AEXPORT3;
REXPORT4=EXPORT4/AEXPORT4;
REXPORT5=EXPORT5/AEXPORT5;
REXPORT6=EXPORT6/AEXPORT6;
REXPORT7=EXPORT7/AEXPORT7;
REXPORT9=EXPORT9/AEXPORT9;
RSSHARE1=SSHARE1/ASSHARE1;
RSSHARE2=SSHARE2/ASSHARE2;
RSSHARE3=SSHARE3/ASSHARE3;
RSSHARE4=SSHARE4/ASSHARE4;
RSSHARE5=SSHARE5/ASSHARE5;
RSSHARE6=SSHARE6/ASSHARE6;
RSSHARE7=SSHARE7/ASSHARE7;
RSSHARE9=SSHARE9/ASSHARE9;
```

```
RTOTALS=TOTALS/ATOTALS;
PROC PRINT;
VAR ID EPD1 EPD2 EPD3 EPD4 EPD5 EPD6 EPD7 EPD9
    EXPORT1 EXPORT2 EXPORT3 EXPORT4 EXPORT5
    EXPORT6 EXPORT7 EXPORT9
AEXPORT1 AEXPORT2 AEXPORT3 AEXPORT4 AEXPORT5 AEXPORT6
AEXPORT7 AEXPORT9
ASSHARE1 ASSHARE2 ASSHARE3 ASSHARE4 ASSHARE5 ASSHARE6
ASSHARE7 ASSHARE9
ATOTALS
REXPORT1 REXPORT2 REXPORT3 REXPORT4 REXPORT5 REXPORT6
REXPORT7 REXPORT9
RSSHARE1 RSSHARE2 RSSHARE3 RSSHARE4 RSSHARE5 RSSHARE6
RSSHARE7 RSSHARE9
RTOTALS
SSHARE1 SSHARE2 SSHARE3 SSHARE4 SSHARE5
SSHARE6 SSHARE7 SSHARE9;
DATA FF; SET AA;
DO I = .90 TO 1.20 BY .050;
ID=1;
PRD1=XPRD1*I;
PRD2=XPRD2*I;
PRD3=XPRD3*I;
PRD4=XPRD4*I;
PRD5=XPRD5*I;
PRD6=XPRD6*I;
PRD7=XPRD7*I;
PRD9=XPRD9*I;
ZEQSZ;OUTPUT;END;
DATA FFF;SET FF;
IF .999<I<1.0001;
AEXPORT1=EXPORT1;
AEXPORT2=EXPORT2;
AEXPORT3=EXPORT3;
AEXPORT4=EXPORT4;
AEXPORT5=EXPORT5;
AEXPORT6=EXPORT6;
AEXPORT7=EXPORT7;
AEXPORT9=EXPORT9;
ASSHARE1=SSHARE1;
ASSHARE2=SSHARE2;
ASSHARE3=SSHARE3;
ASSHARE4=SSHARE4;
ASSHARE5=SSHARE5;
ASSHARE6=SSHARE6;
ASSHARE7=SSHARE7;
ASSHARE9=SSHARE9;
ATOTALS=TOTALS;
KEEP ID AEXPORT1 AEXPORT2 AEXPORT3 AEXPORT4 AEXPORT5
AEXPORT6 AEXPORT7 AEXPORT9
ASSHARE1 ASSHARE2 ASSHARE3 ASSHARE4 ASSHARE5 ASSHARE6
ASSHARE7 ASSHARE9
ATOTALS;
PROC SORT; BY ID;
```

```
PROC SORT DATA =FF; BY ID;
DATA FF; MERGE FF FFF; BY ID;
REXPORT1=EXPORT1/AEXPORT1;
REXPORT2=EXPORT2/AEXPORT2;
REXPORT3=EXPORT3/AEXPORT3;
REXPORT4=EXPORT4/AEXPORT4;
REXPORT5=EXPORT5/AEXPORT5;
REXPORT6=EXPORT6/AEXPORT6;
REXPORT7=EXPORT7/AEXPORT7;
REXPORT9=EXPORT9/AEXPORT9;
RSSHARE1=SSHARE1/ASSHARE1;
RSSHARE2=SSHARE2/ASSHARE2;
RSSHARE3=SSHARE3/ASSHARE3;
RSSHARE4=SSHARE4/ASSHARE4;
RSSHARE5=SSHARE5/ASSHARE5;
RSSHARE6=SSHARE6/ASSHARE6;
RSSHARE7=SSHARE7/ASSHARE7;
RSSHARE9=SSHARE9/ASSHARE9;
RTOTALS=TOTALS/ATOTALS;
PROC PRINT;
VAR ID PRD1 PRD2 PRD3 PRD4 PRD5 PRD6 PRD7 PRD9
    EPD1 EPD2 EPD3 EPD4 EPD5 EPD6 EPD7 EPD9
    EXPORT1 EXPORT2 EXPORT3 EXPORT4 EXPORT5
    EXPORT6 EXPORT7 EXPORT9
AEXPORT1 AEXPORT2 AEXPORT3 AEXPORT4 AEXPORT5 AEXPORT6
AEXPORT7 AEXPORT9
ASSHARE1 ASSHARE2 ASSHARE3 ASSHARE4 ASSHARE5 ASSHARE6
ASSHARE7 ASSHARE9
ATOTALS
REXPORT1 REXPORT2 REXPORT3 REXPORT4 REXPORT5 REXPORT6
REXPORT7 REXPORT9
RSSHARE1 RSSHARE2 RSSHARE3 RSSHARE4 RSSHARE5 RSSHARE6
RSSHARE7 RSSHARE9
RTOTALS
SSHARE1 SSHARE2 SSHARE3 SSHARE4 SSHARE5
SSHARE6 SSHARE7 SSHARE9;
DATA GG; SET AA;
DO I=.5 TO 1.5 BY .1;
DO J = .9 TO 1.20 BY .05;
ID=1;
EPD1=XEPD1*I;
EPD2 =XEPD2*I;
EPD3 =XEPD3*I;
EPD4 =XEPD4*I;
EPD5 =XEPD5*I;
EPD6 =XEPD6*I;
EPD7 =XEPD7*I;
EPD9 =XEPD9*I;
PRD1 =XPRD1*J;
PRD2 =XPRD2*J;
PRD3 =XPRD3*J;
PRD4 =XPRD4*J;
PRD5 =XPRD5*J;
PRD6 =XPRD6*J;
```

```
PRD7 =XPRD7*J;
PRD9 =XPRD9*J;
ZEQSZ;OUTPUT;END;END;
DATA GGG; SET GG;
IF (.999<I<1.0001) AND
(.999<J<1.0001);
AEXPORT1=EXPORT1;
AEXPORT2=EXPORT2;
AEXPORT3=EXPORT3;
AEXPORT4=EXPORT4;
AEXPORT5=EXPORT5;
AEXPORT6=EXPORT6;
AEXPORT7=EXPORT7;
AEXPORT9=EXPORT9;
ASSHARE1=SSHARE1;
ASSHARE2=SSHARE2;
ASSHARE3=SSHARE3;
ASSHARE4=SSHARE4;
ASSHARE5=SSHARE5;
ASSHARE6=SSHARE6;
ASSHARE7=SSHARE7;
ASSHARE9=SSHARE9;
ATOTALS=TOTALS;
KEEP ID AEXPORT1 AEXPORT2 AEXPORT3 AEXPORT4 AEXPORT5
AEXPORT6 AEXPORT7 AEXPORT9
ASSHARE1 ASSHARE2 ASSHARE3 ASSHARE4 ASSHARE5 ASSHARE6
ASSHARE7 ASSHARE9
ATOTALS;
PROC SORT; BY ID;
PROC SORT DATA=GG; BY ID;
DATA GG;MERGE GG GGG; BY ID;
REXPORT1=EXPORT1/AEXPORT1;
REXPORT2=EXPORT2/AEXPORT2;
REXPORT3=EXPORT3/AEXPORT3;
REXPORT4=EXPORT4/AEXPORT4;
REXPORT5=EXPORT5/AEXPORT5;
REXPORT6=EXPORT6/AEXPORT6;
REXPORT7=EXPORT7/AEXPORT7;
REXPORT9=EXPORT9/AEXPORT9;
RSSHARE1=SSHARE1/ASSHARE1;
RSSHARE2=SSHARE2/ASSHARE2;
RSSHARE3=SSHARE3/ASSHARE3;
RSSHARE4=SSHARE4/ASSHARE4;
RSSHARE5=SSHARE5/ASSHARE5;
RSSHARE6=SSHARE6/ASSHARE6;
RSSHARE7=SSHARE7/ASSHARE7;
RSSHARE9=SSHARE9/ASSHARE9;
RTOTALS=TOTALS/ATOTALS;
PROC PRINT;
VAR ID EPD1 EPD2 EPD3 EPD4 EPD5 EPD6 EPD7 EPD9
    PRD1 PRD2 PRD3 PRD4 PRD5 PRD6 PRD7 PRD9
    EXPORT1 EXPORT2 EXPORT3 EXPORT4 EXPORT5
    EXPORT6 EXPORT7 EXPORT9
AEXPORT1 AEXPORT2 AEXPORT3 AEXPORT4 AEXPORT5 AEXPORT6
```

```
AEXPORT7 AEXPORT9
ASSHARE1 ASSHARE2 ASSHARE3 ASSHARE4 ASSHARE5 ASSHARE6
ASSHARE7 ASSHARE9
ATOTALS
REXPORT1 REXPORT2 REXPORT3 REXPORT4 REXPORT5 REXPORT6
REXPORT7 REXPORT9
RSSHARE1 RSSHARE2 RSSHARE3 RSSHARE4 RSSHARE5 RSSHARE6
RSSHARE7 RSSHARE9
RTOTALS
SSHARE1 SSHARE2 SSHARE3 SSHARE4 SSHARE5
SSHARE6 SSHARE7 SSHARE9;
DATA HH;SET AA;
DO I = .50 TO 1.5 BY .10;
DO J=.5 TO 3.0 BY .10;
ID=1;
MP1D=XMP1D*I*J;
MP2D=XMP2D*I*J;
MP3D=XMP3D*I*J;
MP4D=XMP4D*I*J;
MP5D=XMP5D*I*J;
MP6D=XMP6D*I*J;
MP7D=XMP7D*I*J;
MP9D=XMP9D*I*J;
MP13=XMP13*I;
MP14=XMP14*I;
MP19=XMP19*I;
MP21=XMP21*I;
MP24=XMP24*I;
MP31=XMP31*I;
MP32=XMP32*I;
MP41=XMP41*I;
MP42=XMP42*I;
MP43=XMP43*I;
MP46=XMP46*I;
MP47=XMP47*I;
MP49=XMP49*I;
MP52=XMP52*I;
MP54=XMP54*I;
MP57=XMP57*I;
MP59=XMP59*I;
MP62=XMP62*I;
MP64=XMP64*I;
MP65=XMP65*I;
MP69=XMP69*I;
MP72=XMP72*I;
MP74=XMP74*I;
MP75=XMP75*I;
MP76=XMP76*I;
MP92=XMP92*I;
MP93=XMP93*I;
MP94=XMP94*I;
MP95=XMP95*I;
MP96=XMP96*I;
MP97=XMP97*I;
```

```
ZEQPDZ;OUTPUT;END;END;
DATA HHH; SET HH;
IF (.999<I<1.0001) AND
(.999<J<1.0001);
AIQ13=IQ13;
AIQ14=IQ14;
AIQ19=IQ19;
AIQ21=IQ21;
AIQ24=IQ24;
AIQ31=IQ31;
AIQ32=IQ32;
AIQ41=IQ41;
AIQ42=IQ42;
AIQ43=IQ43;
AIQ46=IQ46;
AIQ47=IQ47;
AIQ49=IQ49;
AIQ52=IQ52;
AIQ54=IQ54;
AIQ57=IQ57;
AIQ59=IQ59;
AIQ62=IQ62;
AIQ64=IQ64;
AIQ65=IQ65;
AIQ69=IQ69;
AIQ72=IQ72;
AIQ74=IQ74;
AIQ75=IQ75;
AIQ76=IQ76;
AIQ92=IQ92;
AIQ93=IQ93;
AIQ94=IQ94;
AIQ95=IQ95;
AIQ96=IQ96;
AIQ97=IQ97;
KEEP ID AIQ13 AIQ14 AIQ19 AIQ21 AIQ24 AIQ31 AIQ32
AIQ41 AIQ42 AIQ43 AIQ46 AIQ47 AIQ49 AIQ52 AIQ54
AIQ57 AIQ59 AIQ62 AIQ64 AIQ65 AIQ69 AIQ72 AIQ74
AIQ75 AIQ76 AIQ92 AIQ93 AIQ94 AIQ95 AIQ96 AIQ97;
PROC SORT; BY ID;
PROC SORT DATA=HH; BY ID;
DATA HH; MERGE HH HHH; BY ID;
RIQ13=IQ13/AIQ13;
RIQ14=IQ14/AIQ14;
RIQ19=IQ19/AIQ19;
RIQ21=IQ21/AIQ21;
RIQ24=IQ24/AIQ24;
RIQ31=IQ31/AIQ31;
RIQ32=IQ32/AIQ32;
RIQ41=IQ41/AIQ41;
RIQ42=IQ42/AIQ42;
RIQ43=IQ43/AIQ43;
RIQ46=IQ46/AIQ46;
RIQ47=IQ47/AIQ47;
```

```
RIQ49=IQ49/AIQ49;
RIQ52=IQ52/AIQ52;
RIQ54=IQ54/AIQ54;
RIQ57=IQ57/AIQ57;
RIQ59=IQ59/AIQ59;
RIQ62=IQ62/AIQ62;
RIQ64=IQ64/AIQ64;
RIQ65=IQ65/AIQ65;
RIQ69=IQ69/AIQ69;
RIQ72=IQ72/AIQ72;
RIQ74=IQ74/AIQ74;
RIQ75=IQ75/AIQ75;
RIQ76=IQ76/AIQ76;
RIQ92=IQ92/AIQ92;
RIQ93=IQ93/AIQ93;
RIQ94=IQ94/AIQ94;
RIQ95=IQ95/AIQ95;
RIQ96=IQ96/AIQ96;
RIQ97=IQ97/AIQ97;
PROC PRINT;
VAR ID MP1D MP2D MP3D MP4D MP5D MP6D MP7D MP9D
     MP13 MP14 MP19 MP21 MP24 MP31 MP32 MP41
     MP42 MP43 MP46 MP47 MP49 MP52 MP54 MP57
     MP59 MP62 MP64 MP65 MP69 MP72 MP74 MP75 MP76
     MP92 MP93 MP94 MP95 MP96 MP97
     IQ13 IQ14 IQ19 IQ21 IQ24 IQ31 IQ32 IQ41
     IQ42 IQ43 IQ46 IQ47 IQ49 IQ52 IQ54 IQ57
     IQ59 IQ62 IQ64 IQ65 IQ69 IQ72 IQ74 IQ75 IQ76
     IQ92 IQ93 IQ94 IQ95 IQ96 IQ97
AIQ13 AIQ14 AIQ19 AIQ21 AIQ24 AIQ31 AIQ32 AIQ41
AIQ42 AIQ43 AIQ46 AIQ47 AIQ49 AIQ52 AIQ54 AIQ57
AIQ59 AIQ62 AIQ64 AIQ65 AIQ69 AIQ72 AIQ74 AIQ75
AIQ76 AIQ92 AIQ93 AIQ94 AIQ95 AIQ96 AIQ97
RIQ13 RIQ14 RIQ19 RIQ21 RIQ24 RIQ31 RIQ32 RIQ41
RIQ42 RIQ43 RIQ46 RIQ47 RIQ49 RIQ52 RIQ54 RIQ57
RIQ59 RIQ62 RIQ64 RIQ65 RIQ69 RIQ72 RIQ74 RIQ75
RIQ76 RIQ92 RIQ93 RIQ94 RIQ95 RIQ96 RIQ97
SHARE13 SHARE14 SHARE19 SHARE21 SHARE24 SHARE31 SHARE32
SHARE41 SHARE42 SHARE43 SHARE46 SHARE47 SHARE49 SHARE52
SHARE54 SHARE57 SHARE59 SHARE62 SHARE64 SHARE65 SHARE69
SHARE72 SHARE74 SHARE75 SHARE76 SHARE92 SHARE93 SHARE94
SHARE95 SHARE96 SHARE97;
DATA II;SET AA;
DO I=0 TO 10 BY 1.0;
ID=1;
YEAR=YEAR+I;
ZCIFZ;OUTPUT;END;
DATA III; SET II;
IF I=0;
AIP13=IP13;
AIP14=IP14;
AIP19=IP19;
AIP21=IP21;
AIP24=IP24;
```

```
AIP31=IP31;
AIP32=IP32;
AIP41=IP41;
AIP42=IP42;
AIP43=IP43;
AIP46=IP46;
AIP47=IP47;
AIP49=IP49;
AIP52=IP52;
AIP54=IP54;
AIP57=IP57;
AIP59=IP59;
AIP62=IP62;
AIP64=IP64;
AIP65=IP65;
AIP69=IP69;
AIP72=IP72;
AIP74=IP74;
AIP75=IP75;
AIP76=IP76;
AIP92=IP92;
AIP93=IP93;
AIP94=IP94;
AIP95=IP95;
AIP96=IP96;
AIP97=IP97;
KEEP ID AIP13 AIP14 AIP19 AIP21 AIP24 AIP31 AIP32
AIP41 AIP42 AIP43 AIP46 AIP47 AIP49 AIP52 AIP54 AIP57
AIP59 AIP62 AIP64 AIP65 AIP69 AIP72 AIP74 AIP75 AIP76
AIP92 AIP93 AIP94 AIP95 AIP96 AIP97;
PROC SORT;BY ID;
PROC SORT DATA=II; BY ID;
DATA II; MERGE III II; BY ID;
RIP13=IP13/AIP13;
RIP14=IP14/AIP14;
RIP19=IP19/AIP19;
RIP21=IP21/AIP21;
RIP24=IP24/AIP24;
RIP31=IP31/AIP31;
RIP32=IP32/AIP32;
RIP41=IP41/AIP41;
RIP42=IP42/AIP42;
RIP43=IP43/AIP43;
RIP46=IP46/AIP46;
RIP47=IP47/AIP47;
RIP49=IP49/AIP49;
RIP52=IP52/AIP52;
RIP54=IP54/AIP54;
RIP57=IP57/AIP57;
RIP59=IP59/AIP59;
RIP62=IP62/AIP62;
RIP64=IP64/AIP64;
RIP65=IP65/AIP65;
RIP69=IP69/AIP69;
```

```
RIP72=IP72/AIP72;
RIP74=IP74/AIP74;
RIP75=IP75/AIP75;
RIP76=IP76/AIP76;
RIP92=IP92/AIP92;
RIP93=IP93/AIP93;
RIP94=IP94/AIP94;
RIP95=IP95/AIP95;
RIP96=IP96/AIP96;
RIP97=IP97/AIP97;
PROC PRINT;
VAR ID IP13 IP14 IP19 IP21 IP24 IP31
IP32 IP41 IP42 IP43 IP46 IP47 IP49 IP52
IP54 IP57 IP59 IP62 IP64 IP65 IP69
IP72 IP74 IP75 IP76 IP92 IP93 IP94
IP95 IP96 IP97 IP12 IP23 IP45
AIP13 AIP14 AIP19 AIP21 AIP24 AIP31 AIP32 AIP41
AIP42 AIP43 AIP46 AIP47 AIP49 AIP52 AIP54 AIP57
AIP59 AIP62 AIP64 AIP65 AIP69 AIP72 AIP74 AIP75
AIP76 AIP92 AIP93 AIP94 AIP95 AIP96 AIP97
RIP13 RIP14 RIP19 RIP21 RIP24 RIP31 RIP32 RIP41
RIP42 RIP43 RIP46 RIP47 RIP49 RIP52 RIP54 RIP57
RIP59 RIP62 RIP64 RIP65 RIP69 RIP72 RIP74 RIP75
RIP76 RIP92 RIP93 RIP94 RIP95 RIP96 RIP97;
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